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## A NEW INSTRUMENT FOR MEASURING X-RADIATION<sup>1</sup>

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THE fundamental principle of measurement upon which is based the instrument to be described in this paper is a very old one. It is known in physics as the "null," "zero," "compensation," or "balance" method, and is generally accepted as the most satisfactory procedure for certain types of measurement. The well known Wheatstone bridge and potentiometer, used extensively for electrical measurements, are based on this principle. On the other hand, the apparatus as a whole and the component parts in their special functions have not been employed before for similar purposes, at least to the writer's knowledge.

In order to bring out in a simple way the operation of the device, it is well perhaps to start with a mechanical analogy. Everyone is familiar with the weighing of objects by means of a beam balance. Let us analyze the procedure. We wish to determine the weight of, let us say, a coin by means of the simple balance shown diagrammatically in Figure 1. The first thing to do is to check the balance and if it has a "zero error," adjust it so that the pointer P is opposite the zero mark on the dial, when the pans A and B are empty. The coin is now placed in the pan A and, due to its weight, the pointer moves to the left. Then we add a number of weights of known magnitude to

the pan B until the pointer is again at the zero mark. Under these conditions the action of the coin on the balance is counter-

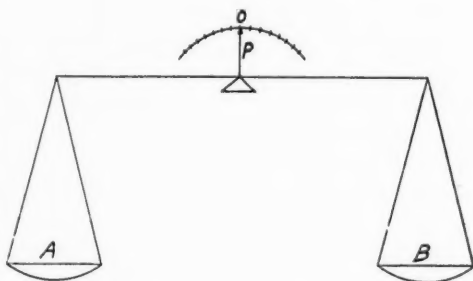


Fig. 1. Simple balance, shown diagrammatically.

acted exactly by the action of the weights. All other factors being equal, therefore, the weight of the coin is equal to the sum of the individual weights placed in the pan B.

The essential elements in this procedure are: (1) A device which is capable of detecting the pull due to the force of gravity acting on a material body, placed in either one of two suitable receptacles; (2) means for adjusting the device to a zero position; (3) a body which, acting on the device, will cause a visible deviation from the zero position, and (4) suitable units of known weight, which, placed in opposition to the first body, will restore the device to the zero position.

<sup>1</sup>Read before the Radiological Society of North America at the Fifteenth Annual Meeting, at Toronto, Dec. 2-6, 1929.

We may now consider how a similar procedure may be employed in a different type of measurement. Let us say that we wish to

therein will rise and the pointer of the gauge will move. The suction pump is now operated to relieve this pressure and the

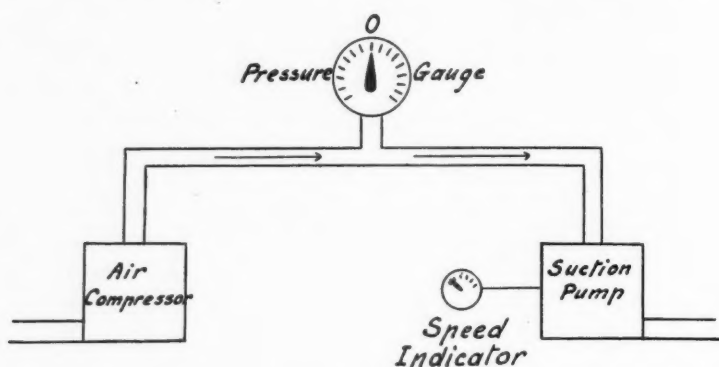


Fig. 2. Hypothetical device for measuring air flow by "balance" method.

measure air flow in cubic centimeters per minute. We must have again the four elements mentioned above. Air flow is capable of producing several effects, any of which may be used to actuate the detecting mechanism. Taking pressure as the effect, our detector must be capable of indicating pressure changes. Then means must be provided for setting the indicator, for instance, a pressure gauge, to any predetermined reading to be taken as zero. As the third element we must have something which produces an air current in a pipe, an air compressor. For the fourth element we shall select a suction pump which is calibrated in such a way that, knowing the speed of the pump, the discharge in cubic centimeters is known. The speed indicator in this pump may be calibrated in revolutions per minute or directly in cubic centimeters per minute, since one is related to the other (Fig. 2).

The process of measuring the air flow from the compressor is as follows: With both the compressor and suction pump stopped, the pointer of the pressure gauge is adjusted to the zero position. Then the compressor is started. Since air is thus forced into the pipe system the pressure

speed is increased until the gauge pointer is again at its initial zero position. When this equilibrium condition or balance is attained, the amount of air carried out by the suction pump per minute is equal to the rate of discharge of the air compressor. The reading of the calibrated speed indicator, therefore, gives the flow of air through the pipe in cubic centimeters per minute.

In an analogous way one may measure the flow of electrons through a wire, that is, an electric current. Of course, for ordinary purposes this procedure is unnecessary because direct reading instruments (ammeters) are available. But when one wishes to measure a very small current the compensation method is unquestionably the best. Since the measurement of X-rays finally reduces to the measurement of an exceedingly small electric current, a suitable compensation device of this character is very desirable.

In this case also we must have the four elements previously mentioned. On account of the small amount of energy available with a minute electric current, the detector element must be very sensitive. Therefore, of the ordinary available devices only elec-

trometers (of the quadrant, quartz fiber, or gold leaf type) are suitable. It is well known that the three-electrode vacuum tube

This is analogous to the filament of a Coolidge tube. Opposite the filament is a metal plate which corresponds to the target of an

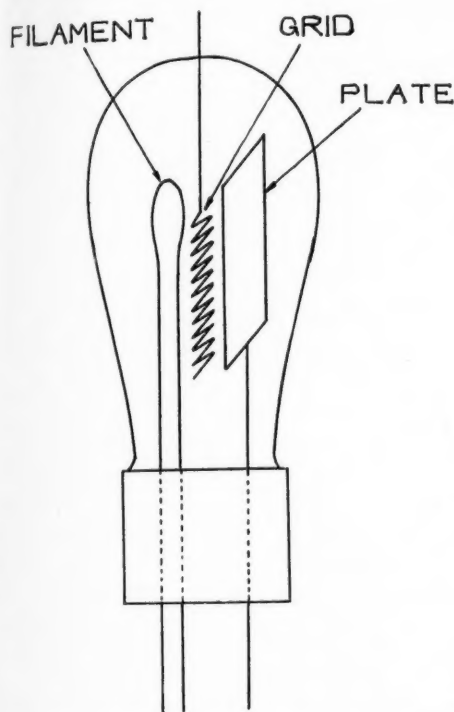


Fig. 3. Three-electrode vacuum tube, shown diagrammatically.

used in radio reception is capable of detecting very small electrical changes, and, therefore, it should be possible to use a device of this sort for our purpose. The problem, however, is not so simple as it appears, and many practical difficulties had to be overcome before a really satisfactory vacuum tube detecting device was constructed.

To simplify the description of such a device it is well perhaps to explain briefly the operation of the three-electrode vacuum tube used in radio sets. Figure 3 shows such a tube schematically. The filament consists of a metal wire which is heated by passing a current through it and is used in the operation of the tube as a source of electrons.

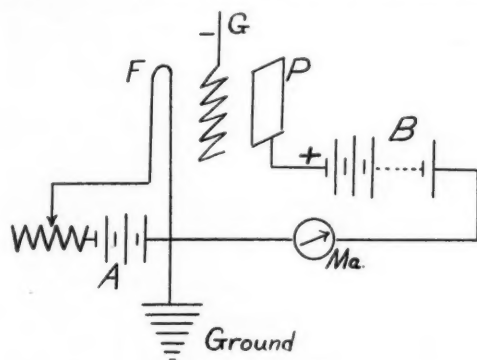


Fig. 4. Simple vacuum tube detector circuit.

X-ray tube. Between filament and plate is suspended a "grid" consisting of metal gauze. The purpose of this grid is to control the flow of electrons from the filament to the plate.

In actual operation the plate is kept at a positive voltage with respect to the filament by means of a suitable battery, or otherwise. Then the electrons liberated by the hot filament are attracted by the plate and travel toward it. Since the intervening grid is a wire mesh with wide spaces between the wires, most of the electrons can pass through and reach the plate. However, the grid is insulated from the other elements of the tube and may be charged at will to any desired potential by means of a suitable battery. If, for instance, it is charged negatively, it will now repel the electrons emitted by the filament and will prevent some or all of them from reaching the plate. If the grid terminal of the tube is left disconnected, the grid will collect some electrons from the filament and will assume a certain negative potential the magnitude of which depends on factors which we need not consider here.

Figure 4 shows the simple circuit in which this is brought about. A is the battery

which heats the filament and B the battery which keeps the plate at a positive potential. When electrical equilibrium has been established the grid assumes a negative potential with respect to ground, and the plate

causes changes in the plate current of greater magnitude, and thus the "signal" is amplified.

Now we may consider the circuit of Figure 5, which is the same as that in Figure 4

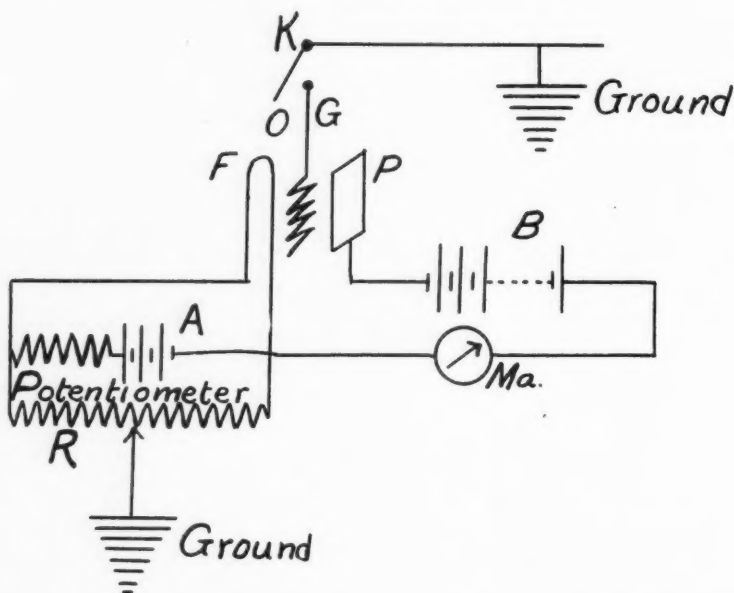


Fig. 5. The same circuit as shown in Figure 4 with the addition of a potentiometer, R, and a grounding key, K.

current, which measures the flow of electrons from the filament to the plate, assumes a certain definite value. This current may be measured by a milliammeter, Ma, in the plate circuit, as shown in Figure 4. If, now, the potential of the grid is changed, the value of the current will also change and the milliammeter will read differently. Very little energy need be supplied to the grid to keep it at any desired voltage. The resultant change in plate current involves a considerable change in energy but this is supplied by the B battery. It is this property of the vacuum tube which makes it so suitable for radio reception. The minute amount of electrical energy collected by the antenna travels to the grid of the tube and changes its voltage. This, in turn,

with the addition of a potentiometer, R, and a grounding key, K. The potentiometer is for the purpose of changing the potential of the filament with respect to ground in such a way as to make the potential which the grid would normally assume identical with ground potential. When the proper adjustment has been made, the key, K, may be closed without changing the plate current. In practice, this adjustment is made by shifting the sliding contact on R until the milliammeter gives the same reading whether the grounding key is open or closed. If we use the vacuum tube as the indicator of electric pressure, this operation corresponds to the zero adjustment of the pressure gauge in the air flow problem discussed above.



In Figure 6 we have the circuit of Figure 5 with the addition of an ionization chamber, M.C., which corresponds to the air compressor and provides the electric current to be measured. One electrode of this cham-

ber is charged positively by the motion of either type of charge. The current which flows from the chamber M.C. to the grid of the vacuum tube in Figure 6, may be thought of as the migration of positive charges from the

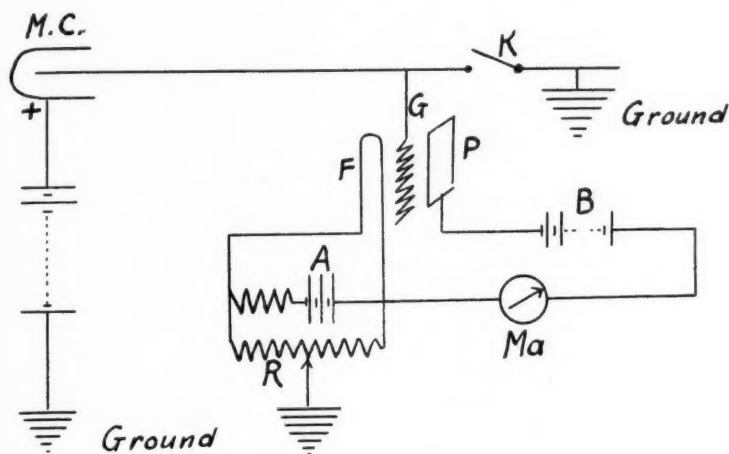


Fig. 6. The same circuit as shown in Figure 5 with the addition of an ionization chamber, M.C., which provides the electric current to be measured.

ber is charged positively by connecting it to a battery, as shown. The other electrode is connected to the grid of the vacuum tube. If the chamber M.C. is exposed to X-rays, an ionization current will pass through it and will travel to the grid. This will change the potential of the grid and consequently the plate current differs from its initial value. With the polarities as shown in the figure, the plate current will be larger when the ionization chamber is exposed to X-rays. We need now something analogous to the suction pump in the air flow measuring device, in order that the milliammeter reading may be restored to its initial or "zero" value. Just as an air current is produced by the motion of molecules, we may think of an electric current as the migration of electric charges. Since there are positive and negative charges we may have an electric cur-

rent produced by the motion of either type of charge. Since positive and negative charges of equal magnitude neutralize each other when they come together, the effect of the current from M.C. may be compensated by the effect of a second current which will carry negative charges to the grid. When complete neutralization occurs at the grid the milliammeter pointer returns to its "zero" position and the two currents are of equal magnitude. Accordingly, we need a device which will permit us to send to the grid the proper compensating current.

Small electric currents can be produced, of course, in a great many different ways, but for our purposes it is not sufficient to produce a current which will balance the X-ray ionization current. We must know in addition the magnitude of the balancing current. Since the two currents are of the

same magnitude, it is just as difficult to measure one as the other. Accordingly, we must find some way of indicating indirectly the magnitude of the compensating current

compensating ionization chamber, C.C., in its relation to the system of Figure 6. A potentiometer,  $Q$ , is provided to supply the voltage to be applied to the chamber C.C.

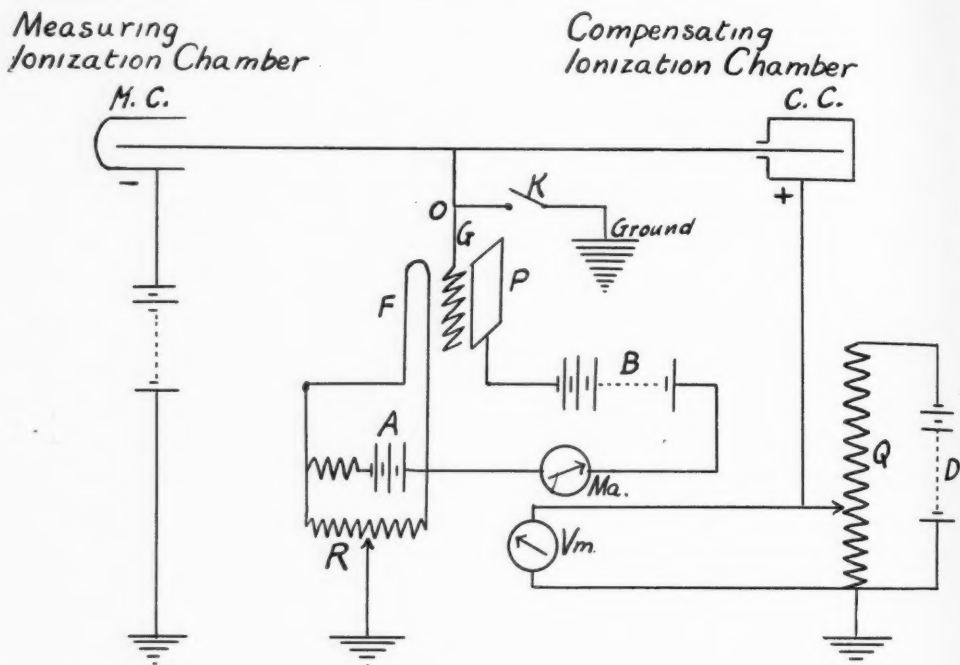


Fig. 7. The connections for the compensating ionization chamber, C.C., in its relation to the system shown in Figure 6.

on a rugged instrument. This can be done in any one of several ways but the most satisfactory arrangement we have found is to use an ionization chamber with some radioactive material. If the radio-active substance is sealed in an air-tight chamber of suitable design, the ionization current produced will depend only on the voltage applied to the chamber. Therefore, having once determined the relation between applied voltage and resultant ionization current, it is necessary later only to measure the applied voltage in order to know the magnitude of the current. This can be done simply by means of an ordinary voltmeter.

Figure 7 shows the connections for the

The voltmeter,  $V_m$ , records this voltage, and corresponds to the speed indicator in the air flow analogy. Knowing the value of the applied voltage, the magnitude of the compensating current can be determined from a calibration curve such as shown in Figure 8. In this curve the current is expressed in electrostatic units, but, of course, it can be expressed in any units. For practical purposes it is preferable to provide a scale on the voltmeter, which indicates directly the value of the compensating current in the desired units. Such a scale can be graduated easily by means of the calibration curve of Figure 8.

With an arrangement of this sort it is im-

portant to know whether the calibration of the compensating chamber remains constant over a reasonably long period. As a matter of fact, unless the calibration does remain constant the instrument as a whole

to measurements which we have made. We can think of no reason why any considerable change should occur in a period of a few years. The amount of radium required to produce a current of the proper

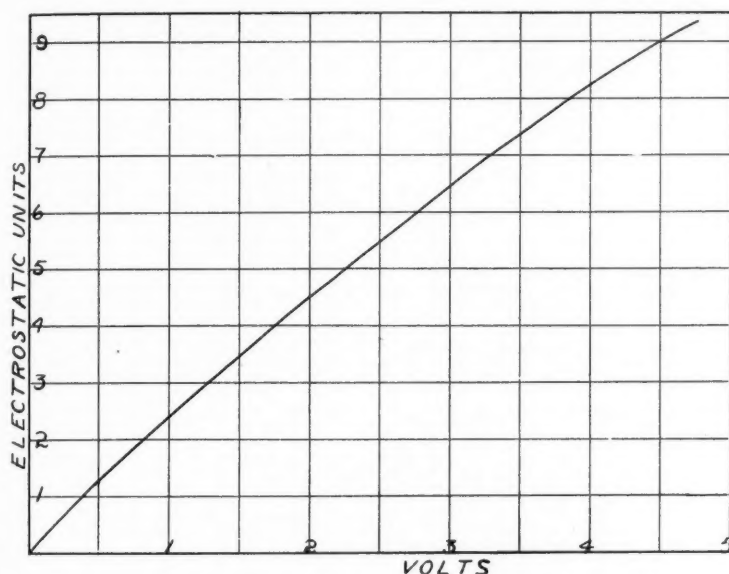


Fig. 8. Calibration curve of a radio-active compensating chamber.

is not of great practical utility. For this reason a thorough investigation of this problem has been made.

We have found that the design of the compensating chamber is of considerable importance. However, a chamber with concentric cylindrical electrodes properly insulated and provided with "guard rings" is very satisfactory. We have used radium as the radio-active material, since it has a long life and is easily available. The radium salt is deposited on one or both of the cylindrical electrodes and the chamber is sealed airtight to prevent loss of radon. After sealing, the radio-activity of radium increases for about a month and then remains practically constant for a considerable time. The ionization within the chamber remains constant at least for several months, according

to measurements which we have made. We can think of no reason why any considerable change should occur in a period of a few years. The amount of radium required to produce a current of the proper

magnitude for ordinary X-ray measurements is very small and its cost is negligible. The operation of the measuring device is independent of the design of the ionization chamber used for the measurement of X-rays. That is, the instrument is capable of measuring a very small unidirectional current, no matter how it is produced; therefore, any type of ionization chamber or source of small current may be used. However, for practical X-ray measurements in the clinic it is preferable to use a rather large chamber, which produces a fairly large current with ordinary beam intensities. This permits the calibration of the X-ray machine according to the radiation output, so that the radiologist may duplicate treatments at any time. In the opinion of the writer the use of a small ionization chamber, which is

kept on the patient during the treatment, is not desirable (1). For practical work in the X-ray department we have designed the chamber shown schematically in Figure 9. It consists of a lead-lined brass shell of the

is provided at the emergence side of the chamber so as to permit the beam to pass through without striking any part of the chamber except the three electrodes.

A comparison of the ionization produced

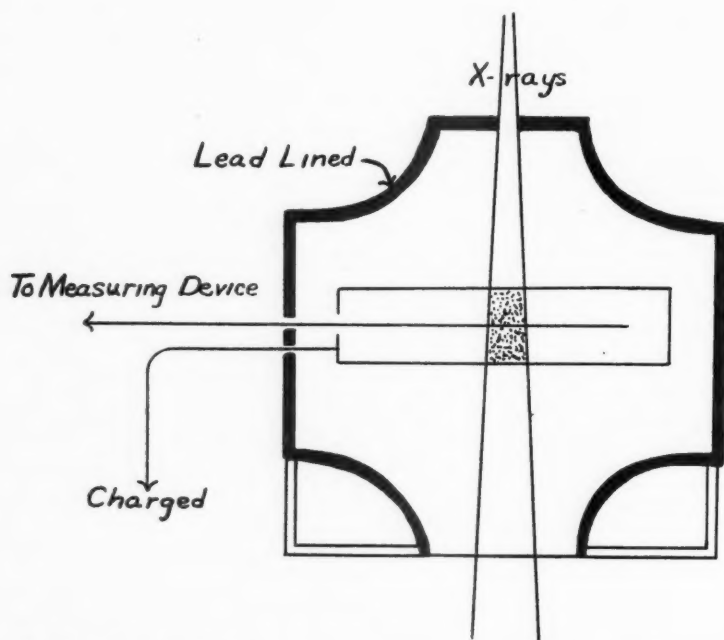


Fig. 9. "Drum head" ionization chamber intended for routine measurements in the X-ray clinic.

shape shown, enclosing three parallel plane electrodes. These are made of thin animal skins ("drum heads") stretched over suitable rings and coated with India ink. The separation between the plates is 2 cm., and, therefore, saturation current may be obtained without the use of high voltages. The beam of X-rays to be measured travels at right-angles to the electrodes and traverses them. Since they are very thin and of organic nature, they absorb little radiation of the hardness usually employed in radiotherapy. Limiting diaphragms of different diameters may be used with the chamber to vary the size of the X-ray beam admitted into the chamber. A large opening

in this chamber with that produced in a "standard open air chamber" (2) when the same beam of radiation is used, is given in Table I. In this experiment the X-ray tube voltage was about 185 K.V., and the copper filter was varied from 0 to 2.5 millimeters. From the ratios given in the last column of the table, it will be seen that the two chambers agree closely throughout the wide range of filtration used. It may be mentioned here also that the "drum-head" chamber may be used as a standard chamber within ordinary limits. That is, the intensity of an X-ray beam may be determined in r per minute, without previous calibration. For this purpose the "ionized volume" is determined by

the area of the diaphragm and the distance between the outer electrodes. For very hard X-rays no appreciable error is introduced by this procedure. For high voltage X-rays filtered by a small thickness of copper the direct  $r$  per minute determinations with the drum-head chamber are 3 or 4 per cent too low.

Employing the "balance method" of measurement, the electrode of the ionization chamber which is connected to the measuring instrument proper is at zero potential with respect to ground when the reading is taken. On this account the cable connecting the chamber to the vacuum tube device need not have extremely high electrical insulation. We have found that in practice ordinary "lamp cord" serves the purpose very well. Furthermore, the length of the cable does not influence the reading of the instrument. We have used a cable one hundred feet long which permits us to calibrate every machine in the X-ray Department with the instrument in a fixed position. With a measuring device of the electro-scope type, however, the readings are dependent on the length of the cable used and the insulation must be as high as possible. A satisfactory flexible cable for this purpose is difficult to make since it must be highly insulated, must have no air spaces where ionization may take place, and must have a constant electrical capacity in any position. It may be said, in fact, that the cable is the weakest point of all electro-scope devices. In the case of our instrument this difficulty has been eliminated completely.

From the point of view of constancy of calibration, the instrument described here possesses distinct advantages. In the electro-scope type of instrument the calibration may change, due to variations in the following factors: (1) sensitivity of the electro-scope (or electrometer) proper; (2) electric capacity of the electro-scope, cable, and ionization chamber; (3) electrical insulation on account of age, dirt, or humidity.

Accordingly, for accurate work it is necessary to check the calibration of the instrument with radium every time that it is used. In the case of our instrument the calibration is influenced by only two factors: (1)

TABLE I

Filter (Mm. Cu)	Air Chamber	Drumhead Chamber	Ratio
0	935	931	0.997
0.039	412	408	0.995
0.078	289	284	0.982
0.16	183.3	182.5	0.997
0.32	118.4	118.6	1.002
0.64	70.7	70.9	1.003
1.28	38.2	39.1	1.024
2.50	16.7	17.5	1.046

changes in the radium compensating chamber, and (2) variations in the voltmeter calibration. Changes of appreciable magnitude in these two parts of the apparatus are very unlikely. Check measurements made with radium over a period of several months show that readings can be duplicated from day to day within 1 per cent. Furthermore, any part of the instrument may be replaced easily without the necessity of calibrating the apparatus as a whole. In other words, the compensating and measuring chambers and the voltmeter can be calibrated individually as often as desired. Insofar as the vacuum tube system is concerned any part of this may be replaced without affecting in the least the calibration of the instrument. Since standard tubes and parts are used, they may be bought in any radio shop at small cost.

Only two manual operations are required in making measurements with this device: (1) "setting the zero," and (2) compensating the current produced in the X-ray ionization chamber. In either case the proper adjustment is made by the turning of a knob.

It will be noted, however, that the device, as described so far, embodies some batteries which naturally require attention from time to time. While the use of batteries does not introduce serious difficulties, it is neverthe-



less a drawback. For this reason we have developed an alternating current instrument in which no batteries at all are used. It is necessary only to connect the device to a source of alternating current and all the required voltages are provided by a suitable "power pack," as in the so-called "all electric" radio sets.

The behavior of this instrument in actual operation, as well as the soundness of the principles involved, enables us to say that it fulfills all requirements demanded by routine measurements in the radiological clinic. A very critical attitude has been maintained throughout the long period of development, looking for faults and sources of error. Many difficulties have been encountered but no insurmountable ones. The instrument has been used in our laboratory for some time both for experimental work and routine measurements, and has been very satisfactory. A similar instrument has been in operation for the daily measurement of radon during the last few months. It has maintained its original calibration with remarkable constancy, so that the discrepancy in the readings given by our radium standard has been consistently less than 1 per cent during this period.

The writer takes pleasure in expressing his indebtedness to his assistants, Mr. George D. Barclay, Mr. Edwin Loble, and Mr. Leonidas Marinelli for their wholehearted and valuable co-operation in the construction and testing of the instrument.

#### SUMMARY

- A. A new type of X-ray measuring instrument is described, in which use is made of the well-known balance or compensation method of measurement.
  - (1) A vacuum tube device is used as the "balance detector."
  - (2) An ionization chamber containing a small amount of radium is used as the "compensator."
- B. The instrument possesses several distinct advantages.
  - (1) Extremely high electrical insulation is not necessary.
  - (2) The length of the cable joining the ionization chamber to the measuring device proper does not influence the readings. Therefore a long flexible cable can be used, permitting the observer to be in a separate room at any desired distance from the X-ray machine.
  - (3) The instrument can be calibrated to read directly in roentgens per minute (no stop watch is required).
  - (4) It has a wide range, permitting the measurement of X-ray beams of very different intensities.
  - (5) It has a high sensitivity combined with stability and ruggedness.
  - (6) The use of radium or other long-lived radio-active material in the compensating ionization chamber insures an unusual permanence of the calibration.
  - (7) No delicate apparatus is embodied in this instrument.
  - (8) The vacuum tubes and other "radio" parts used can be replaced (at small cost) *without affecting the calibration* of the instrument. These parts are readily obtainable throughout the country.
  - (9) Simplicity of operation.
- C. A new ionization chamber is described briefly in this paper.
  - (1) It permits the determination of the X-ray beam intensity directly in roentgens per minute without previous calibration, over a considerable range of hardness.
  - (2) A potential of a few hundred volts is sufficient to produce saturation in this chamber with all practical beam intensities.
- D. The measuring device proper is capable of determining the magnitude of a very

small, unidirectional, electric current. Accordingly it may be used to measure anything which can be made to produce an electric current. In addition to X-rays, by suitable accessories, it can measure—

- (1) Radio-active substances and their radiations;
- (2) Visible light;
- (3) Ultra-violet light.

E. The instrument described in this paper has passed the experimental stage and has been in actual operation for a considerable time. Its practical utility at the Memorial Hospital has been definitely established.

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#### DISCUSSION

DR. LAURISTON S. TAYLOR (Washington, D. C.): As Dr. Failla began to have one slide after another put on the screen, they grew apparently more and more complicated until my hair almost stood on end at the prospect of what it would be if he kept up much longer. But I do not believe most of you realize how extremely simple this final circuit is, compared to the corresponding vacuum tube circuit used by one or two foreign instruments which employ the vacuum tube for their energy-measuring instruments. The particular advantage of this circuit, as I see it, from a practical point of view and as Dr. Failla pointed out, is that it is null reading, thereby making it possible to use almost any old kind of vacuum tube in the detector circuit. So that, if your technician drops a hammer on the vacuum tube, all you need to do is to go home and take a tube out of your radio circuit and you are ready to go on again, whereas, with the other instruments, you have to send over to Europe for a tube—

possibly have to have the tube calibrated—and be without your instrument for some time. From a practical point of view, the importance of that feature is very hard to exaggerate.

Dr. Mutscheller has talked about a new measuring device, and Dr. Failla has talked about two more, and in a little while I will have a couple more to talk about, so it may sound kind of discouraging to the people here. We are talking about these things and we keep on talking about them, and you begin to wonder where we are going to stop or if they are any good to begin with. The reason is this: the development of these new chambers does not necessarily mean that there is any fundamental difficulty involved in our intensity measurements. The thing is, that only by developing new chambers, many of which will be superseded by others as time goes on—only by doing that kind of work can we arrive in the end at something which is thoroughly practical and useful. So that if the physicists are going to keep on talking about such apparatus, as they will for some time, don't get discouraged, because in the end maybe we will have something that is pretty usable.

Another very important point which Dr. Failla's paper has brought out is this question of making instantaneous measurements, for his circuit is adjusted until you determine by a single reading the intensity of the beam. The reading does not need to be extended over a long period of time; there is not a step which is involved; you do not need to bring time into your calculations; it reads the intensity of the beam at a given instant, and I think that only by such readings as that are we going to get away from a very confusing point, the distinction between the X-ray beam intensity and the X-ray dose. This question has been under argument for a number of years. The medical doctor thinks in terms of "dose," and when you try to tell him anything about a dose, you really find that you

have to tell him two or three thousand things before he really begins to know anything about it, and then maybe he doesn't know very much. All we can surely tell him is an X-ray beam intensity, and let the given dose be "up to" the doctor, not "up to" a physical instrument devised by a physicist. This instrument which Dr. Failla has described as being an intensity measuring instrument, can, of course, be made into an integrating instrument. However, the average X-ray machines—99.44 per cent of them—are much steadier, that is, their output remains much more constant, over the duration of a treatment, than the physician can possibly measure his biological reaction, so it seems quite sufficient if you measure an X-ray beam intensity at the beginning of the day for that particular set of conditions, record the time and other various factors, the important thing being an instantaneous measure of X-ray beam intensity. That corresponds to good general physical practice, and I think as long as measurements of this kind are going to be made, the nearer we can come to the accepted physical prac-

tice, the less confusion we are going to have in the end.

DR. A. MUTSCHELLER (New York): Referring to Dr. Failla's paper, I would like to add just one thing, which is, that compensation methods, wherein an instrument is employed to show that two currents exactly balance each other, have been in the past very successfully employed, in physical measurements. We have been using such a method right along, but without a vacuum tube, but this method suffers from the disadvantage that we have to deal with exceedingly small currents which are difficult to measure. On the other hand, vacuum tubes, wherever employed, because their complicated characteristics might play tricks, are usually to be regarded with very much distrust. In Dr. Failla's scheme, however, the characteristics of the vacuum tube are eliminated, and for that reason (in order to be brief) I would just like to say that I believe this method will constitute a very helpful improvement and undoubtedly will be very valuable.

# THE EARLY RECOGNITION OF GASTRIC ULCER AND CARCINOMA AS REVEALED BY ROENTGEN-RAY STUDIES<sup>1</sup>

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THE roentgen diagnosis of a gastric lesion depends principally upon the presence of a filling defect. In a large proportion of ulcerative and carcinomatous lesions, this pathognomonic sign is present; but occasionally, especially in early cases, no filling defect may be observed, even though the patient may present defi-

Insufficient attention, however, has been directed to the recognition of gastric disease in which filling defects are not revealed. This type of stomach usually appears normal and not infrequently the diagnosis remains uncertain from an X-ray point of view. Although it is well recognized that filling defects are the only positive indica-



Fig. 1-A. Tracing of stomach from roentgenogram, showing the normal peristaltic waves.

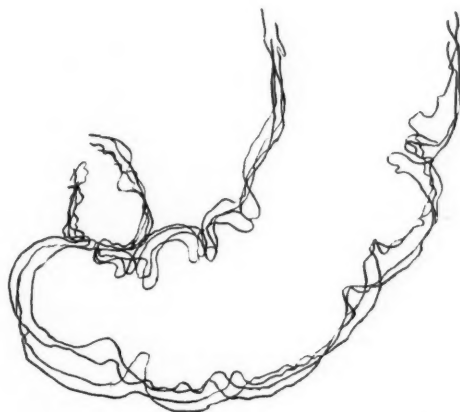


Fig. 1-B. Superimposed tracings of a normal stomach roentgenogram.

nite clinical evidence of gastric disease. These unusual types require most careful study and at times frequent roentgen examinations become necessary, in order that the conclusions gained both by X-ray and clinical findings may be correlated and the diagnosis be more definitely established. The diagnosis of a gastric lesion with the characteristic filling defect presents no difficulty and is not considered in this paper.

tions of gastric disease, 'secondary roentgen signs must also be considered as an additional aid in arriving at an early diagnosis. There are many secondary signs, but the most important are (1) an absence or diminished peristalsis in the area involved, and (2) spasm.

In serial roentgenography with films taken at short intervals, the stomach appears to alter its contour; and it may be observed that the peristaltic indentations become deeper and shallower, coincident

<sup>1</sup>Read before the Radiological Society of North America at the Fifteenth Annual Meeting, at Toronto, Dec. 2-6, 1929.

apparently with systolic and diastolic changes in the musculature of the entire organ (1). The normal peristaltic waves as observed fluoroscopically, apparently take their origin in the fundus and travel

involvement of both curvatures, with diminution of peristalsis.

The fixed appearance of the stomach when constantly present in the same position is usually the result of a gastric lesion.

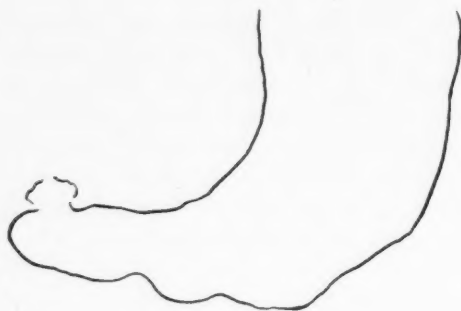


Fig. 2-A. Tracing of stomach, showing the stereotyped or fixed appearance; note the diminished peristalsis and an abnormal roundness of the lesser curvature.



Fig. 2-B. Same case, with roentgenograms superimposed, illustrating the absence of peristaltic waves.

toward the pylorus. According to Alvarez these peristaltic waves appear as ripples originating from the region of the cardia, travelling in different directions toward the pylorus. When serial roentgenograms are superimposed a change in each roentgenogram, revealing different phases of peristalsis, is observed. An absent or diminished peristalsis or a break in the peristaltic wave is presented in the films in the form of a fixed appearance of the curvatures of the stomach. This fixation, however, is more especially observed on the lesser curvature. When films revealing gastric lesions are superimposed, there is an absence of the different phases of peristaltic waves, presented on the films in the form of a stereotyped or fixed appearance.

This condition is observed in various types, depending upon the lesion present: (1) a straight line appearance, usually noted on the lesser curvature; (2) a roundness of the lesser curvature; (3) a possible in-

Kuttner terms the straight line appearance the cross-bar (Riegel) sign of Frankel. He observed this sign in one-fifth of twenty-six cases and attaches great importance to it as an early sign of gastric disease.

There can be no question but that in many instances in which organic gastric disease is at hand, the roentgen examination of the stomach being essentially negative, this fixed appearance is noted. This sign indicates changes usually due to carcinoma or ulcer and is usually observed in the early stage of these affections.

Polygraphy, a method of obtaining several exposures in rapid succession on one film, is described by Bernstein (4) as an ideal means to determine the arrest of peristalsis, which is said to be of considerable diagnostic aid in the localization of ulcers. This method although valuable is not always practical. In several instances we have found the shadows of polygraphy confusing and, due to the ease with which the



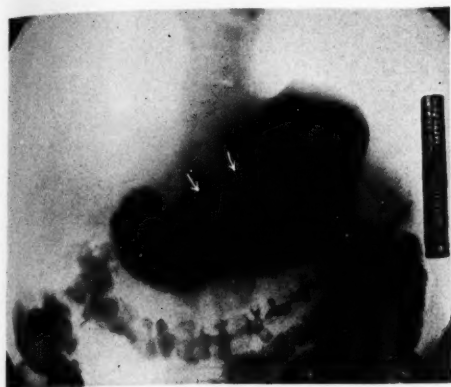


Fig. 3-A. Roentgenogram showing the stereotyped or fixed stomach; note the roundness of the lesser curvature. Tracings of this case are illustrated in Figures 2-A and 2-B.



Fig. 3-B. Three months later, showing a carcinomatous filling defect, confirmed by operation.

stomach tracings can be made from a series of films and be superimposed, we consider the latter method preferable for the study of peristalsis.

The stereotyped, fixed, or straight line appearance of the stomach curvatures must be recognized as a fairly constant sign of carcinoma and ulcer. The extensive stereotyping is usually observed in carcinoma, most frequently involving the cardia of the stomach, while the straight line appearance due to a break in the peristaltic wave is not uncommonly the result of an ulcer, but may however also be produced by carcinoma. These signs were constantly present in a large series of films of these affections, taken in our clinic. The fluoroscopic examination does not reveal these changes in detail and the findings are usually indefinite, but when they are observed at times, cannot be relied upon until corroborated by a series of films.

The late changes of carcinoma presenting large filling defects, palpable masses, and obstruction are not considered in this study. Since early recognition of this disease is important as a means of a possible operative cure, any sign which will aid in the recognition of this condition must be con-

sidered of the greatest importance. The sign described above must be considered as an aid in this direction.

In early carcinoma both curvatures may become involved, revealing an absent or diminished peristalsis, with the typical stereotyped or fixed stomach. The stomach is usually situated high under the left diaphragm, showing no filling defect, and may appear smaller than normal. The emptying time is usually rapid but may be normal in some instances. No palpable masses can be detected at this stage of the disease. However, as the condition progresses after some time, a filling defect may be detected in the cardia of the stomach, eventually involving the lower end of the esophagus and the cardio-esophageal opening.

In the ulcerative type the affection usually occurs on the lesser curvature and the break in peristalsis is not so marked. In this form the typical straight line effect is revealed, being constantly present on all the films.

Persistent spasm is a frequent finding in



Fig. 4-A. Shows a small projecting filling defect on lesser curvature of pyloric antrum.



Fig. 4-B. Twenty-one months later, showing an irregular cardia, the straight line effect of the lesser curvature, and a small annular filling defect of pylorus.

gastric disease, the pyloric region of the stomach being the most common site of this condition; the greatest care must be exercised in its interpretation. Although this may be the only sign of a lesion present, especially noted in ulceration, the roentgenologist must first determine whether this spasm is produced by a cicatricial filling defect due to an organic lesion or whether it is reflex.

Spasm occurring on the greater curvature as the result of ulceration, known as an incisura and caused by the irritation of the circular muscular fibers, giving the roentgen appearance of an hour-glass stomach, is an example of one of the many instances in which this secondary finding may be of importance in the diagnosis. This sign, however, frequently occurs, on the other hand, without the presence of a filling defect. In a series of sixty-seven cases of

gastric ulcer, under observation in our clinic, the presence of an incisura was revealed without a demonstrable filling defect in eleven instances. In one, however, the patient was examined on three separate occasions and no defect was observed, but an incisura was constantly noted. At operation a gastric ulcer was revealed, a finding which was also confirmed by autopsy. In several instances, following numerous examinations, filling defects were finally observed several years after a diagnosis of gastric ulcer had been made from the presence of an incisura alone. The filling defect, when present, usually occurs opposite the incisura. At times, instead of noting a defect, the straight line appearance as described above is observed.

In gastric disease, the earliest pathological changes occur in the mucous membrane at the stage when roentgen signs are still

absent, excepting for spasm, although in some instances peristalsis may be inhibited as a result of irritation. The next stage, however, reveals induration and thickening of the tissues involving the muscular layer, and, as a result of these changes, interference with the normal peristalsis may be observed in the roentgen study. A later stage shows tumor or ulcer formation which is noted by the presence of a defect.

Every gastro-intestinal examination requires a thorough fluoroscopic study, the patient being examined in the antero-posterior, lateral, and oblique positions. A series of films are made in these positions, not only for record, but also to determine the possibility of the presence of a small lesion as well as to avoid overlooking the stereotyped, fixed, or straight line appearance of the stomach, which may occur as the result of the fluoroscopic method. It must be recognized that the fluoroscopic examination cannot always be relied upon in the early diagnosis of small or early lesions of the stomach.

The presence of spasm, revealed as an incisura, the straight line effect and fixed or stereotyped appearance of the stomach suggesting a gastric lesion will often present the additional data required in connection with the clinical manifestations and laboratory findings, which will in most instances assist in arriving at an early and correct diagnosis.

It is interesting to note that the routine test meal showed an achylia in all of our cases in which the roentgen study revealed the stereotyped stomach and in which a diagnosis of carcinoma had been made.

#### CASE REPORTS

The following case reports illustrate briefly the value of the roentgen findings.

Mrs. G. R., aged 61, ascribes her present disturbance to an accident in January, 1928, when she fractured three ribs. In June of



Fig. 4-C. Same case as shown in Figures 4-A and 4-B, also illustrating the irregularity of the esophagus at the cardiac end, and also showing the constancy of the straight line effect of the lesser curvature.

that year she began to complain of nausea, regurgitation, and dull pressure in the epigastrium. There was an absence of pain, and the discomfort bore no relation to food. In May she became jaundiced for a period of four weeks and on July 3rd sought medical attention. An X-ray examination at this time revealed a stereotyped, fixed appearance of the gastric outline which appeared constant on all the films. The fluoroscopic examination was negative. No demonstrable filling defect could be detected. The findings suggested a gastric lesion. The gastric contents presented an absence of free HCl; total acidity of 12; blood positive. She was admitted to the hospital in September, three months following the first examination, with complaint of difficulty in swallowing, and vomiting. The X-ray examination at this time revealed a narrowing and irregularity of the pyloric half of

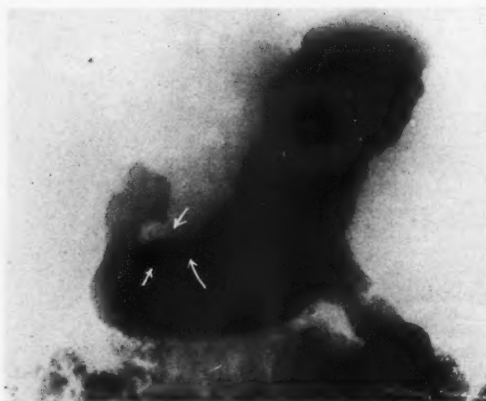


Fig. 5-A. Shows the straight line effect on the lesser curvature of the pyloric antrum, at the arrows.

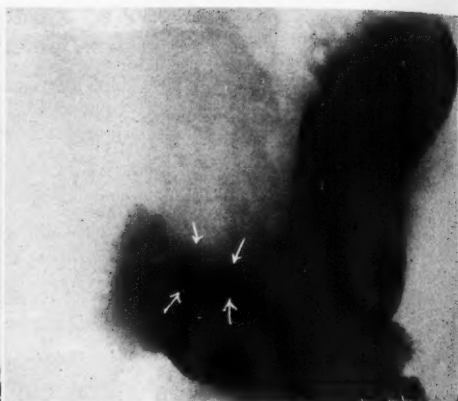


Fig. 5-B. Same case, eight months later, illustrating an irregular filling defect.

the stomach, suggesting a malignant condition. Fifteen days later, on re-examination, the esophagus presented a definite obstructive lesion at the cardia. The Wassermann test was negative. At operation a large carcinomatous mass was detected at

the cardia of the stomach, extending to the pylorus.

Mrs. A. L., aged 58. This patient gave a history of stomach disturbance of many years' standing, associated with pains in the right side. Recently a loss of appetite and black stools were noted in addition to some loss of weight; vomiting did not occur. In February, 1927, an X-ray examination revealed the typical stereotyped or fixed appearance of the stomach, especially noted on the lesser curvature. No demonstrable defect was observed; the pylorus was somewhat narrowed. The changes suggested an old ulcer. In October, 1928, still complaining of her stomach disturbance, she was re-examined and a partial obstruction of the esophagus at the cardia end was observed. The cardia of the stomach was irregular and fixed in appearance; the pylorus showed a small annular filling defect; a large 18-hour retention was also detected. The roentgen diagnosis was carcinoma of the cardia of the stomach, involving the cardiac end of the esophagus, and annular carcinoma of the pylorus, with pyloric obstruction. The examination of the gastric contents was interesting, in that in 1918 there had been an absence of free HCl, with total



Fig. 6-A. Shows the straight line appearance of the lesser curvature at the arrows.



Fig. 6-B. Same case as shown in Figure 6-A, illustrating the constancy of the straight line.



Fig. 6-C. Roentgenogram of the stomach of the same case, repeated on the following day showing the constant appearance of the lesser curvature noted in Figures 6-A and 6-B.

acidity of 12. In May, 1924, there was still an absence of HCl, and total acidity of 11, and on November 17, 1925, the test meal still showed an achylia. On October 3, 1928, the tube could not be passed beyond the cardiac end of the esophagus.

Mrs. M. F., aged 62, had complained of stomach disturbance since 1920, with pains in the left side and back. There were present pains on swallowing, vomiting, poor appetite, sour regurgitation. A fluoroscopic examination at this time revealed a small stomach, with changes suggesting an ulcer in association with right upper quadrant adhesions. No films were made. In September, 1928, or eight years later, she complained of difficulty in swallowing, loss of weight, pains in left chest, substernal distress, and vomiting. The X-ray examination at this time showed a slight retardation of the barium meal at the cardiac end of

the esophagus, but no irregularity of the lumen was observed. The stomach was small, well up under the costal margin, emptied rapidly, and presented the typical fixed or stereotyped appearance without the presence of a filling defect. The pylorus and duodenal cap were normal. The findings suggested a gastric lesion. On the fluoroscopic examination these changes were not detected. The diagnosis of a malignant gastric lesion also involving the cardiac end of the esophagus was made. Examination of the gastric contents eight years previously had showed an absence of free HCl. In September, 1928, there was still an achylia present. The Wassermann test was negative. An exploratory operation performed on November 30, 1928, revealed an indurated annular mass at the cardia of the stomach, involving the cardiac end of the esophagus. The stomach was located high



under the costal margin, the mesenteric glands were enlarged and indurated. The diagnosis of carcinoma was confirmed.

Mr. F. L., aged 71, dated his disturbance as having been present since 1923. He complained of pains in the stomach immediately following meals, but retained a good appetite. Neither vomiting nor loss of weight was noted. An appendectomy had been performed in 1918. In March, 1924, an X-ray examination revealed a broad, flattened, straight line appearance of the lesser curvature of the pyloric antrum, and a diagnosis of a gastric lesion, probably an ulcer, was made. In November, or eight months later, he still complained of pains without relation to food. At this time there was still no vomiting or loss of weight. An X-ray examination revealed an irregular filling defect in the same region as the straight line appearance noted in the first examination. These changes suggested carcinoma. The patient later developed a palpable mass. The gastric contents in March showed an absence of free HCl; blood positive. In November there was still an achylia present.

#### SUMMARY

The early signs of gastric disease as determined by radiological methods are presented, with a description of these findings. The importance of arriving at an early diagnosis without the presence of an organic filling defect is stressed. The fluoroscopic examination in the early stages of gastric disease may not reveal any abnormal changes; however, a series of films usually presents evidence of spasm or abnormal peristalsis. Frequent roentgen examinations are often necessitated, especially when the roentgen diagnosis and the clinical findings do not appear to be in accord.

#### CONCLUSIONS

1. A stereotyped, fixed, or straight line appearance of the curvatures of the stom-

ach as revealed by roentgen examination occurs as the result of a thickening, induration, and infiltration of the tissues of this organ.

2. Diminished or absent peristalsis or a break in the peristaltic wave is probably the earliest roentgen sign of gastric disease.

3. A small stomach, located high, presenting the fixed and stereotyped appearance, emptying rapidly, even though showing no filling defect, is frequently the result of a carcinoma at the cardia of the stomach.

4. Spasm is frequently the result of a gastric lesion; the incisura is a typical example. It occurred in 16 per cent of the cases of ulceration.

5. The presence of a filling defect is not always necessary in order to establish the roentgen diagnosis of a gastric lesion.

6. The proper interpretation and evaluation of the roentgen signs here described is highly important in the early diagnosis of gastric disease.

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#### DISCUSSION

DR. L. T. LEWALD (New York): There is one phase of the diagnostic features that I think I can illustrate by a case in which it would not have been necessary to give barium to outline the tumor, as it is shown in contrast to the gas bubble in the stomach. The tumor (Fig. 1) occurred in the cardiac end of the stomach, and tended to obstruct the esophagus. The diagnosis has been confirmed by operation.



Fig. 1. Carcinoma of cardiac end of stomach. Note that the tumor can be seen in contrast to the air in the gas bubble, so that the diagnosis might have been made without the use of opaque material.

DR. EDWARD S. BLAINE (Chicago): I wish to add a bit of confirmatory information to certain of the points Dr. Feldman has presented. May I relate an interesting experience that occurred to me rather early in my X-ray work in gastric investigations? Being a first experience this particular event became fixed in my memory, so that I have never forgotten it, but have observed the same X-ray findings frequently since that time.

I had before me a large sized male individual about sixty years of age whose weight of more than two hundred pounds offered considerable difficulty in the way of fluoroscopy. The usual quantity of opaque material was ingested without incident and the shadow of its passage through the esophagus presented nothing unusual. Below the diaphragm the shadow failed to develop the usual gastric configuration. The stom-

ach was of exceedingly small, "steer-horn shape," lying high under the diaphragm, heart, and liver—so high that it was entirely out of reach to palpatory effort. The opaque material poured out into the small bowel without appreciable delay and I was unable to detect any peristalsis. Serial and multiple superimposed exposures made immediately afterwards confirmed the presence of a very small stomach, out of all proportion to so large an individual, and with no appreciable peristaltic waves. I considered this complex as indicating an organ with inflexible walls, and, although the clinical evidence was not regarded by the patient's physician as compatible, I made an interpretation of an extensive scirrhus carcinoma of the stomach. Fortunately for me, this patient was operated on and this diagnosis found to be correct.

Undoubtedly some of those in this audience will recall my routine technic in gastric X-ray examinations, a feature of which is the "polygram," consisting of five or more superimposed exposures of the opaque filled stomach on one  $8 \times 10$  film. Four of these are made in every examination, in addition to other single exposures of larger sized films. These four  $8 \times 10$  films give us twenty different exposures, indicating a like number of positions of the gastric waves, one-half of which are made in the morning study and the other half from four to six hours later. On these twenty exposures on four small films we have approached the effect of a fluoroscopic study for a like period, and in this manner have been able to detect local alterations of peristaltic action as well as total absence of movement of the gastric walls. In some cases of early ulcer, as well as early malignancy, we have made a correct deduction on the basis of this technic.

DR. A. R. BLOOM (Detroit, Mich.): I wish to add that I have much appreciated Dr. Feldman's paper, because as a rule when

findings of carcinoma of the stomach are made, it is too late to operate. There is one point brought out by Dr. Feldman which I think should be emphasized, and that is the employment of repeated X-ray examinations. The Mayo Clinic have shown recently that early diagnosis of cancer can be made on repeated examinations. Along this line, I want to recite two cases.

The first case was that of a woman about 38 years of age, who had complained of gastro-intestinal symptoms for about three years. She had been examined in three different clinics, and each time had been diagnosed as negative. When I saw her, a year after her last examination, there was a niche high upon the lesser curvature, about the size of the end of the thumb. I re-examined her in about a month and there was no change in size. She was operated on and the ulcer excised. Grossly there was no evidence of malignancy; on microscopic examination numerous young fibroplastic cells were found. Four months later she died of diffuse metastasis and a mass was found at the site of the lesion.

Another case was of a man about 50 years of age, who had been complaining of heartburn for some ten years. He had had three or four gastric hemorrhages. The week before I saw him, his symptoms had suddenly changed for the worse, and he experienced no relief from soda, as he had done on previous occasions. When I examined him, I noticed a ragged filling defect at the pyloric end of the stomach and made a diagnosis of carcinoma based on this defect, and also on the history of a sudden change of symptoms. Two months later I re-examined him. He was feeling much better and the filling defect was markedly reduced, so that he probably had an inflammatory condition around the pyloric region.

DR. L. A. MILKMAN (Scranton, Pa.): Of special interest were Dr. Feldman's re-

marks about the straightening of the lesser curvature—not only a straightening of the lesser curvature but also an actual shortening. This actual shortening leads one frequently to look out for gastric malignancy.

DR. S. A. PORTIS (Chicago): I am very much interested in Dr. Feldman's discussion of his subject. The inflexibility of the lesser curvature is an important roentgenological factor. However, another very important finding where flexibility cannot be determined is the evidence of a small, fine, moth-eaten irregularity of the lesser curvature side. This results, as a rule, from very rapidly growing tumors. They metastasize early, and even though there may not be material enlargement of the original lesion, surgery in these cases offers very little, if any, assistance.

DR. FELDMAN (closing): I thank you for the discussion of this paper. In reference to the cascade stomach, we recognize that as an abnormal stomach in most instances, but it does not fall into the type of stomach that I want to impress upon you. We recognize a cascade stomach as one with a defect: the type of stomach which I want to bring out is one without any demonstrable filling effect.

With regard to symptoms, of course the gastro-intestinal patients that I have seen usually have gastro-intestinal symptoms.

Most clinicians disregard the early roentgen signs, because they do not know anything about them. Very few essayists have stressed the early roentgen signs. In fact, when we first spoke of the sign, it was disregarded; and until we had enough cases, especially operative cases, to prove our signs, we were hesitant ourselves and a suggestive impression was given.

In reference to the shortening of the stomach, I mentioned in my paper that the

stomach is usually small, taking into consideration that there is some shortening.

There is a peculiar smallness of the stomach which we do not usually see normally.

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**Mount Vernon Hospital and Radium Institute. Editorial. Brit. Med. Jour., June 28, 1930, No. 3625, p. 1185.**

The Mount Vernon Hospital at Northwood has been converted into an institution for the study of malignant disease under research conditions. The medical staff has been reorganized and augmented by workers from other institutions, chosen because of their interest and experience in the radium treatment of cancer.

A working scheme has been drafted for affiliation between the Radium Institute and the Mount Vernon Hospital, under the deanship of Sir Cuthbert Wallace, the combined institution to be called the Mount Vernon Hospital and Radium Institute National Post-graduate School of Radiotherapy. Radium will be furnished by the National Radium Commission, which also supplies the Westminster Hospital Radium Annex, where experiments, on behalf of the Commission, are being carried on with a 4-gram "bomb," in

order to determine the value of mass irradiation and long-distance radium therapy.

WALLACE D. MACKENZIE, M.D.

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**On the Pathogenesis of Eventration of the Left Side of the Diaphragm. Pietro Del Buono. Rivista di Radiologia e Fisica Medica, March, 1930, II, 118.**

The author discusses various causes of eventration of the diaphragm, and concludes that in a certain limited number of cases it is possible to admit the congenital origin of the lesion. The more probable causes are inflammatory or neoplastic diseases in the thorax or in the abdomen, from which the diaphragm may be injured, sclerosed, or atrophied. The most frequent cause, however, is ulcerative or neoplastic disease of the stomach, which can be demonstrated radiographically and which is responsible for adhesions and indirect pressure on the diaphragm.

E. T. LEDDY, M.D.

## QUANTUM ENERGY OF X-RAYS: A NEW METHOD OF MEASURING IT<sup>1</sup>

By A. MUTSCHELLER, Ph.D., NEW YORK CITY

IT MAY be regarded as significant that so little is known about the possible existence or non-existence of specific biological effects of certain wave lengths of X-rays. A possible reason why this field remains practically untouched is that the wave theory of X-rays explains only a certain few facts, but fails to account for many important characteristics of X-rays. The modern quantum theory, on the other hand, accounts for many important characteristics of X-rays, notably those of scattering and the conversion of primary radiant energy into other forms of energy. All these processes are the basis for the utilization of X-rays in therapy. The reason why the quantum theory is not applied more extensively is that the methods, known up to the present, of experimentally measuring the various factors in the quantum expression are too difficult and too elaborate for clinical or even for experimental application.

A new method is described in this paper which by a simple and convenient process enables one to determine the energy of radiation quanta. It is to be expected that this method may be instrumental in directing research and clinical workers into the simpler and much more successful ways of thinking in terms of the modern quantum theory, to take the place of the still extensively applied wave idea of X-rays.

### THEORETICAL

In terms of the quantum theory a beam of X-rays is to be regarded as consisting of a stream of a definite number of small units of energy known as quanta. These quanta are projected out from the target of the

X-ray tube, and, on penetrating substances (such as, for instance, a mass of biological tissue), there is an effect produced that is proportional to the number of the quanta multiplied by the energy carried by each quantum. In this respect these quanta behave as if they had a definite mass, leading us to think of them exactly as we think of a blast of discrete particles of which each particle carries a definite amount of kinetic energy.<sup>2</sup> Then we know that the bombarding effect of such a stream of particles is measured as the product of the number of particles times the energy of each particle.

Now, in connection with X-ray radiation, we know that the quantum energy is a function of the wave length<sup>3</sup> and also that the wave length is fixedly related to the average absorption coefficient of the radiation.<sup>4</sup> Then, this average absorption coefficient is definitely connected with two coefficients that are easily measured as transmission values of intensities through a known substance as an absorption medium.<sup>5</sup> Each of these functions is represented or expressed by an equation and these three equations can be substituted to give one that expresses the energy of the quanta in terms of these two measurable absorption intensities.<sup>6</sup> The resulting equation is somewhat unwieldy for direct computation and for that reason it is most convenient to read the energy of the

<sup>2</sup>This is the idea of *inertia of energy*, which is one of the principles of Einstein's special relativity, according to which "every quantity of energy of any kind whatever has associated with it a certain amount of mass." See Compton, Appendix 1.

<sup>3</sup>Sommerfeld, Arnold J. W., *Atombau und Spektrallinien*, 3rd Ed., Chapter 4.

<sup>4</sup>Richtmyer, F. K., *Physical Rev.*, July, 1921, XVIII, 13.

<sup>5</sup>The well known experimental absorption equation  $\log(I_0 - I_x) = m x$ .

<sup>1</sup>Read before the Radiological Society of North America at the Fifteenth Annual Meeting, at Toronto, Dec. 2-6, 1929.

<sup>6</sup>All mathematical references and equations are omitted from this paper. These will be published in a physical journal.



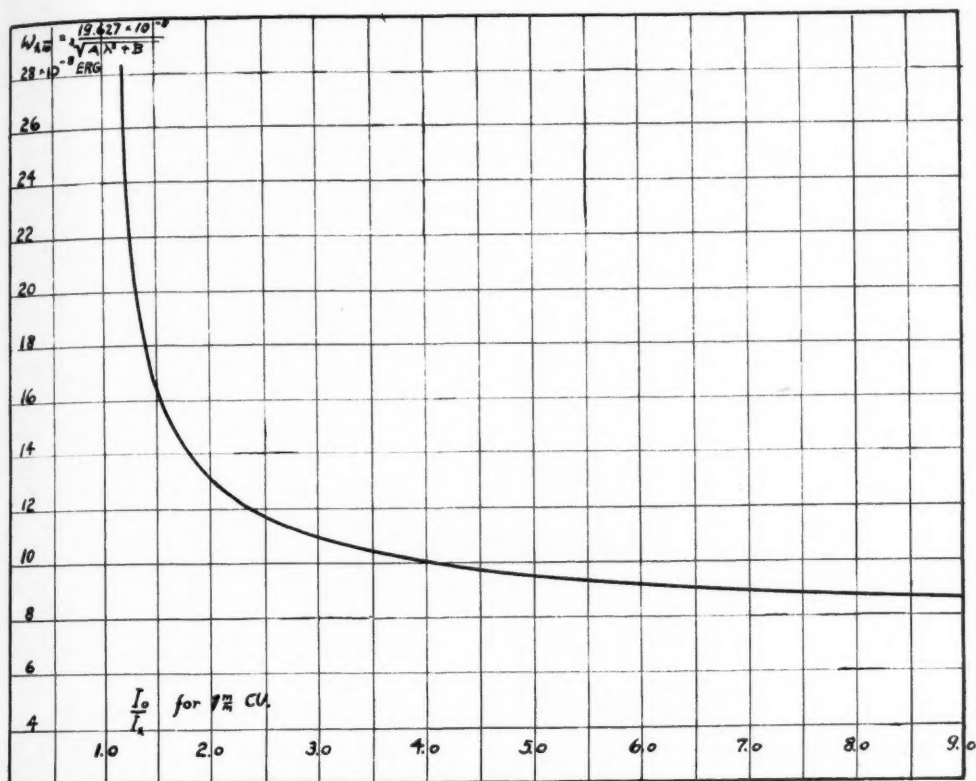


Fig. 1. Curve from which the quantum energy in ergs is read in terms of the ratio of radiation intensities transmitted through 1 mm. of copper.

quanta as ergs from the curve given in Figure 1.

#### EXPERIMENTAL

At the outset of the experimental work there are three hypotheses either for verification or disproval. These are:

(1) That the dosimeter or iontoquantimeter employed for measuring the radiation intensity actually measures the total energy of the radiation;

(2) That it measures the radiation energy independent of the wave length, and

(3) That the method hereinbefore outlined accurately measures the energy of the quanta, and that this energy as measured

by this method is directly proportional to the biological effect of the radiation.

For the experimental testing of these propositions the radiation from a well evacuated high voltage deep therapy tube energized with 4 ma. of constant potential current at voltages measured from the minimum wave length of spectra made with a Seemann spectrograph was employed.<sup>7</sup> A series of absorption curves were made in copper at voltages in steps of 10 kilovolts, from 200 kilovolts downward. From these curves the absorption ratios were read at points on the curve 1 mm. apart. From the curve of Figure 1, then, the quantum energy

<sup>7</sup>Mutscheller, RADIOLOGY, May, 1929, XII, 388.

TABLE I

K.V. d. c. from $\lambda$ min.	$\frac{I_0}{I_x}$	Mm. Cu passing 10%	r/min. 10 div. = 3.75 r	$W = \text{ergs}$ $\times 10^{-8}$ *	$W$ from curve $\text{ergs} \times 10^{-8}$
129	2.75	1.08	1.60	11.3	11.40
133	2.54	1.22	1.72	11.84	11.75
143	2.26	1.40	1.85	12.42	12.40
152	2.10	1.58	1.90	12.64	12.80
162	1.98	1.81	2.05	13.14	13.25
171	1.83	2.09	2.20	13.97	13.80
181	1.65	2.50	2.40	14.86	14.90
190	1.51	3.00	2.75	16.43	16.60

\* $W$  calculated with the equation  $W = \frac{9}{4} \times 10^8 \frac{r}{m} + 4.2$ , using for  $r/\text{min.}$  the experimental values in Column 4.

in ergs was read for each of the voltages or wave lengths generated. These are recorded in Column 6 of Table I.

Returning now to the theoretical requirements referred to earlier, we find that at every voltage the total radiation energy as measured with the dosimeter is to be equal to the number of quanta multiplied by the energy of each quantum. If, now, the electrical energy input into the X-ray tube is kept constant, then the number of the quanta making up the radiation would be constant, and thus, by dividing the total ionization energy by the quantum energy, we should obtain a constant numerical value for the number of quanta produced by the fixed electrical discharge through the tube.

To fix the electrical discharge through the tube and thereby to fix as constant the number of quanta of X-rays produced, we proceeded as follows: From the absorption curves (Fig. 2) it was determined at what filter thickness at the various voltages employed, there is transmitted the same percentage of the total radiation, with the proviso that the point representing the filter must lie on the straight line part of the curves. This is necessary in order to satisfy the conditions upon which the validity of the absorption equation used in the derivation of the energy equation is based. The transmission value of 10 per cent was

found to be practical, and total intensity measurements in r-units (which are electrostatic units) were made with several dosimeters at filter thicknesses that transmitted exactly 10 per cent of the radiation. The values obtained with one dosimeter actually independent of wave lengths and, of course, obtained by intrapolation from measurements through various available filter thicknesses, are recorded in Column 3 of Table I.

It remains now to test the validity of the three hypotheses with these experimental data. For this purpose there are two ways open. First, by plotting the total radiation intensities measured against the quantum energy, as is done in Figure 3. The points are located along a straight line, indicating that there is a direct linear relation between these factors. Then, the straight line is represented by an equation of the general form of that given by Einstein<sup>8</sup> to represent the ejection of electrons under the impact of a radiation, wherein the energy of the ejected electrons is equal to the energy of the quantum energy minus the energy required to pull these electrons out of the atoms from which they are to be freed. The physical conditions are, therefore, identical with those demanded by the theory.

But still further, we can calculate with the equation of the straight line plot, the values of the quantum energy at each voltage and enter these values calculated from the experimental ionization intensities on the

<sup>8</sup>For an interesting discussion of this equation, see Richtmyer, *Introduction to Modern Physics*, 1928, pp. 163-65.

curve used to read off the quantum energy, and we find, in Figure 4, that the measured values agree, within experimental errors, with the theoretical requirements.

In the second place, we can, as above out-

#### METHOD OF MEASURING QUANTUM ENERGY

This is the method as it should be carried out in the practical therapy laboratory for the purpose of defining or of measuring the

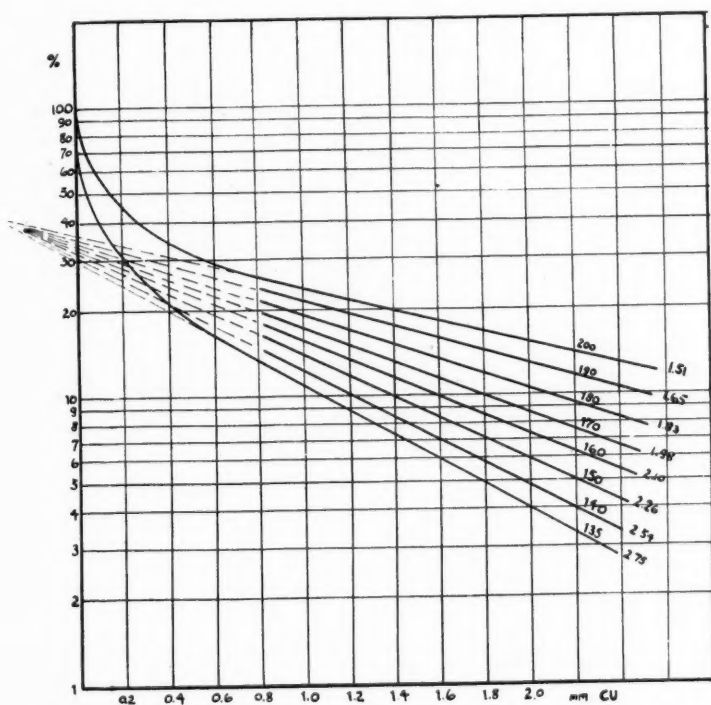


Fig. 2. Absorption curves in copper of various voltages constant potential current.

lined, calculate the value for the number of quanta produced by 10 per cent of the radiation corresponding to 4 ma. at a distance of 55 cm. from the target, and we find, as shown in Table II, that the value for the number of quanta is the same at all voltages. Both these tests, therefore, indicate that each one of the propositions made must be answered in the affirmative.<sup>9</sup>

<sup>9</sup>Regarding the relation of total energy and biological action of the rays see R. Glocker, *Strahlentherapie*, 1929, XXXIII, 199; *Festschr. d. Technisch. Hochschule zu Stuttgart*, 1929, p. 109.

quality of the radiation employed. It may be carried out in either of two ways, of which the second is the preferred one.

The radiation is filtered with a forefilter sufficient to produce a constant absorption coefficient. For this purpose usually a filter of from  $\frac{1}{2}$  to  $\frac{3}{4}$  mm. of copper is required: in order to be on the safe side, 1 mm. is better. The intensity of the radiation is measured and then exactly 1 mm. of copper is added and the intensity is measured again. Either the smaller discharge time is divided

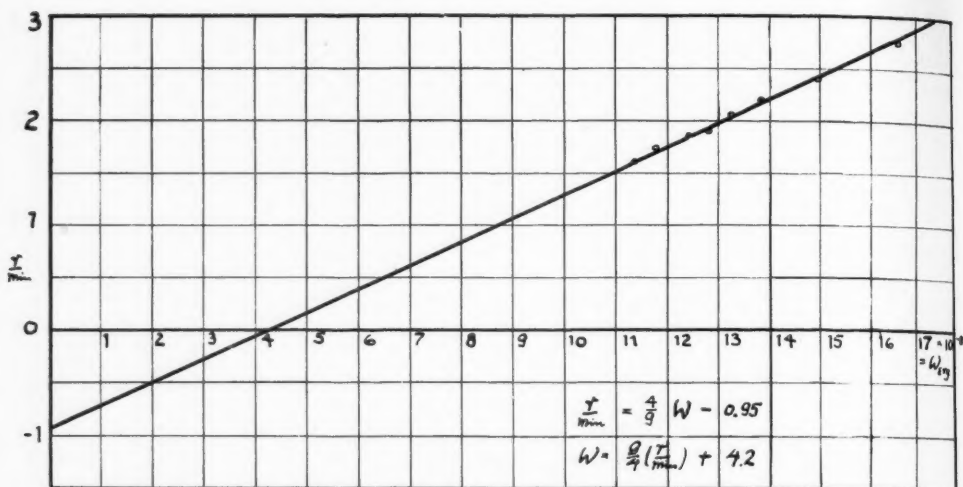


Fig. 3. Plot of the total energy of the radiation measured with a dosimeter and the quantum energy.

TABLE II

Since  $r/\text{min.} = \frac{4}{9} W - .95$ , a dose of 1 r is produced when the number of quanta per c.c. of air is

$$n = \frac{r/\text{min.} + .95}{.444 W}$$

K.V. d. c. from $\lambda$ min.	r/min. meas.	W ergs $\times 10^{-8}$	n
129	1.6	11.4	$.505 \times 10^8$
133	1.72	11.75	$.513 \times 10^8$
143	1.85	12.40	$.510 \times 10^8$
152	1.90	12.80	$.502 \times 10^8$
162	2.05	13.25	$.510 \times 10^8$
171	2.20	13.80	$.514 \times 10^8$
181	2.40	14.90	$.506 \times 10^8$
190	2.75	16.60	$.502 \times 10^8$
			$4.062 \div 8 = .508 \times 10^8$ for the number of quanta

into the larger or the smaller intensity is divided into the larger, and the quotient is the value  $I_0/I_x$ . In the curve of Figure 1, directly above this quotient on the base line is found the quantum energy of the radiation in ergs.<sup>10</sup>

The second method consists in making a

<sup>10</sup>A condition is that the electrodes or the walls of the ionization chamber shall not be exposed to X-rays. Either a chamber described in RADIOLOGY, May, 1924, II, 330, or one shown in Figure 5 is to be employed.

complete absorption curve in copper and plotting it on semi-logarithmic paper. The data to be plotted are calculated from the discharge times measured by dividing the discharge time measured with the entire filter into the discharge time with 1 mm. less copper as a filter, multiplied by 100. This gives the percentage of the radiation transmitted through 1 mm. of copper for which the curve is computed. It is usually most convenient to employ as filters 0.2 mm. of copper and to take ten readings, to a total filter thickness of 2 millimeters. It is absolutely necessary to test the measuring chamber for leakage and for non-exposure of the electrode, and the best test for that purpose is that the absorption curve from points representing more than  $\frac{1}{2}$  or  $\frac{3}{4}$  mm. of copper must be a straight line. An absorption curve offers the assurance over the "two point" method, that no errors in measurements are present and that small experimental errors are evenly distributed on both sides over the entire curve. Also, an absorption curve indicates the correct filter thickness<sup>11</sup> to use, and in a general way lends

<sup>11</sup>Mutscheller, RADIOLOGY, May, 1924, II, 330.

itself to very useful interpretations. Of course, readings of intensities may be taken along any part of this curve, so long as the

wave lengths, then the assumption is proven. Many instruments in use do not satisfy this condition, and, therefore, it must be said

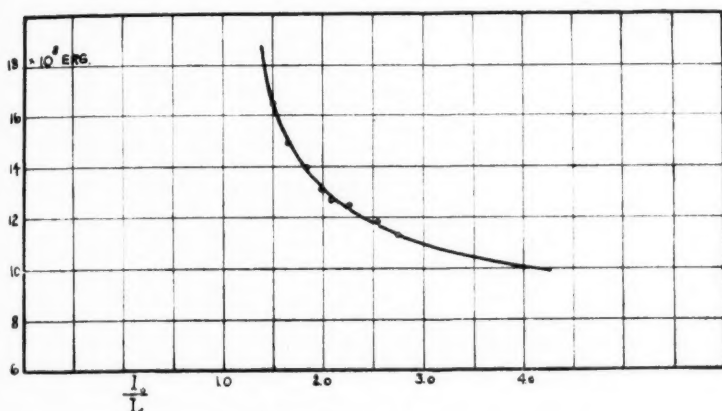


Fig. 4. The experimental values are plotted over the theoretical curve. They show satisfactory agreement between experiment and theory.

distance between the points taken represents 1 mm. of copper, and then the quantum energy is read from Curve 1.

#### DISCUSSION

We can now look into the matter as to what can be done with these results.

In the first place, we are now using various forms of ionization chambers for measuring radiation intensities in terms of r-units, which are assumed to measure the radiation energy degenerated in 1 c.c. of air under standard conditions. It is also assumed that this is true for all wave lengths within certain limits. Now, inasmuch as such an instrument measures total energy, i.e., the product of quantum energy times the number of quanta, there is nothing to indicate that the assumption is proven correct. But now we can measure the average energy of the individual quanta and if the total ionization current divided by the quantum energy gives the constant value  $0.508 \times 10^8$  for the number of quanta for all

that they do not measure independent of the wave length.

Furthermore, the definition of the r-unit has long been a *casus belli*. But on the basis of these quantum developments it is an easy matter to define the r-unit in terms of the number of quanta which, within a certain definite solid angle from the tube, are required to produce an ionization current of 1 E.S.U. There is an almost unlimited field for expansion and simplification now possible, and there are good prospects that the entire dosage problem will be very considerably simplified. We may look with anticipation in the direction of important disclosures in research on the biological effects of various wave lengths or quanta energies. We have to think only of the antirachitic wave length band and the so-called Gurlwitsch or mitogenetic rays to feel that there is no reason to consider the existence of more such selective effects at specific wave lengths as impossible.

This work will, therefore, be continued in our laboratories as intensively as is pos-



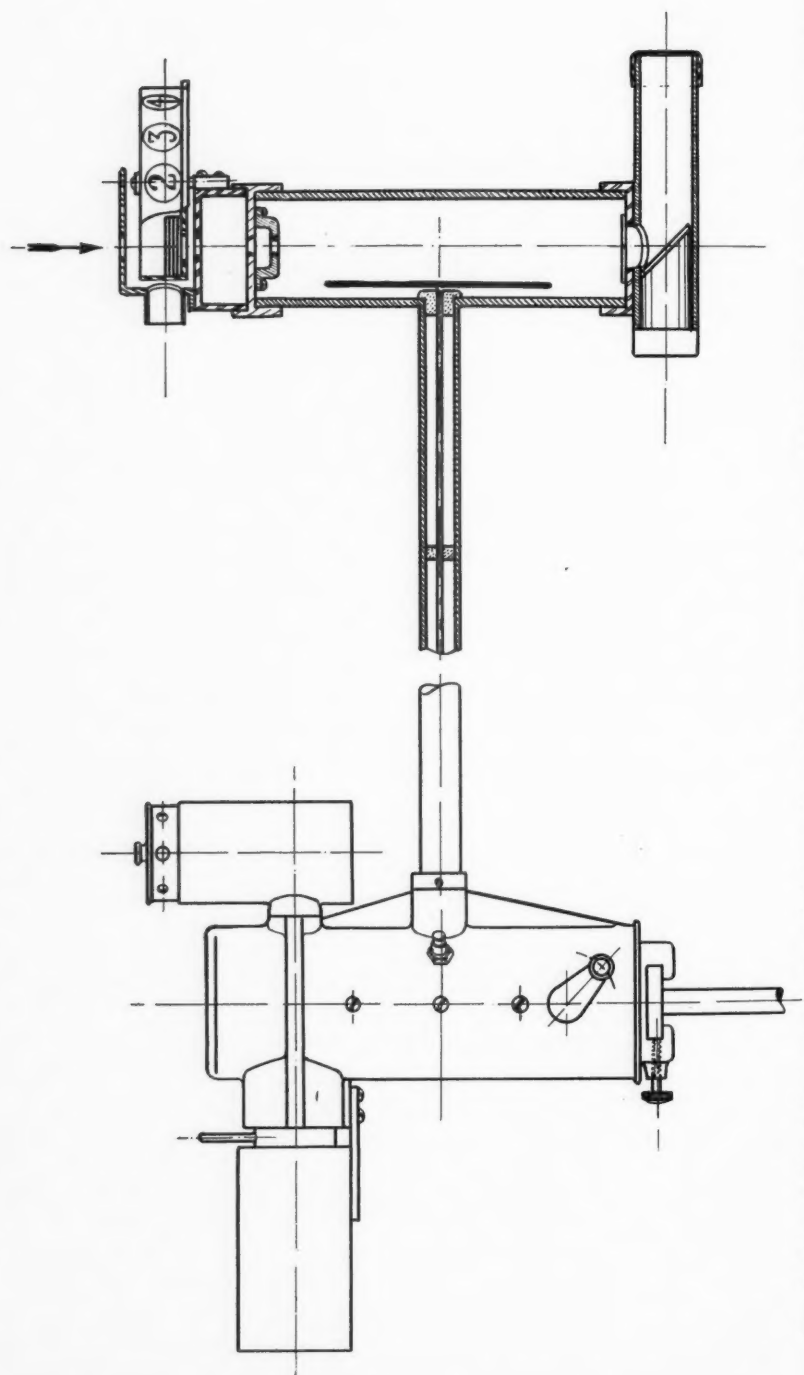


Fig. 5. An ionization instrument found practical for making of absorption curves in copper. The headpiece contains a rotatable drum with various copper filters. Note the treble slit arrangement. Below is a reflecting mirror to direct the through path for the rays from the target of the tube.

sible, but I invite the co-operation of every one who is inclined and disposed to participate in this work.

## SUMMARY

In this rather early report is shown—

1. A new method of measuring experimentally the quantum energy in ergs of X-ray radiations produced at various voltages.

2. A method of testing dosimeters, *i.e.*, ionization chambers used for intensity measurement, for their dependence or non-dependence on wave lengths.

3. It is pointed out how the clinical aspect of radiation therapy can be simplified by the application of the quantum principle, and that in all probability the clinical effects of X-ray radiation run parallel not with the total ionization effect, the wave lengths, or the absorption coefficients, but with the quantum energy and the total number of the quanta.

4. In view of the facts outlined, it is suggested that clinical radiation data and especially quality measurements be made and recorded in terms of quanta energy or ergs.

## DISCUSSION

DR. FRANCIS CARTER WOOD (New York): The problem of trying to discover whether the ionization chamber of the open type, which I believe was originally devised by Perrin and developed by Duane, measures energy or not is one which has occupied the workers in many laboratories for some time. It seems to me that it is the last important problem of radiation measurement left to be solved. Of course, all other ionization chambers have to be checked against the open one to see whether their readings are correct. Of late one of the commercial

machines has been tested against flies' eggs, which do not show any wave length effect, and found to correspond within about 2 per cent to the biological test. Practically, I think the biological test is the important thing, for the radiologist does not care anything about the purely physical side. The important thing is that we are applying radiation to another biological object, the human body. It is interesting to see how many people have guessed at this question of relationship between the ionization and energy. Both sides have proved to everybody's satisfaction that the ionization does not read energy and that it does read energy! So far as I am concerned, I have always held to the view stated to me fifteen years ago by Professor William Duane, that the only possible relation of the action of X-rays would be the energy one, that is, the effect would be directly proportioned to the energy absorbed. For this reason I have always assumed, though knowing it not proved, that the open ionization chamber did measure energy. In our biological experiments the column of air has about the same absorption as the flies' eggs, and therefore we are working with exactly the same portion of the absorption curve.

As to this ingenious paper, the question is if the short wave lengths give off a larger number of quanta, why do not those quanta do more damage to the cells? And thus we are thrown back on the same old thing, that they are less absorbed in the tissues, and back we go to the absorption of the open ionization chamber as the sole measure of the amount of effective energy which hits minute biological elements. What that effective energy does when it hits the human body, in which very complicated scattering takes place, is quite another problem, and I have confined myself solely to discussing the phenomena which occur in these small eggs or very small tumor particles where all scattering is eliminated; in other words, simplifying the problem as much as pos-

sible. The more complicated problem belongs to the clinician.

DR. LAURISTON S. TAYLOR (Washington, D. C.): Dr. Mutscheller's work is clearly along the most advanced lines, and while I am not completely clear in my own mind at this time about the full details of it, inasmuch as I have not seen his completely worked out publication, it is to be hoped that it will lead us somewhere correctly, and in terms of energy. Up to the present there have been only two or three determinations made of the absolute energy of an X-ray beam. These determinations involve some of the most difficult tasks that have been confronted, because of the extremely weak intensity being dealt with. I believe that for a very powerful water-cooled tube operating at one hundred milliamperes and about sixty kilovolts the energy is one one-hundredth of an erg per minute, which is almost less than nothing at all. The method used to investigate this involves a medium which can be exposed to the X-ray beam, and absorbing the total amount of energy, it then becomes possible to measure the resulting very slight increase in the temperature of this body. Dr. Terrill has tried this at the Crocker Institute. Crowther has tried it in England and Kulenkampff and Rump have tried it in Germany, and unfortunately all of them disagree, so that so far as an absolute measurement of X-ray energy is concerned, we are still in doubt. It is to be hoped that this work of Dr. Mutscheller's, while not an absolute method of measuring the energy, will at least give us a way of arriving at the energy by some other route.

DR. G. FAILLA (New York): Since I have not read Dr. Mutscheller's paper I find it impossible to discuss certain technical points in it from the abridged presentation I have heard. Of course, it would be important to measure the actual energy in an X-ray beam. Many attempts have been made

in the past, but they have not been very successful on account of the minute quantities of energy involved. Dr. Mutscheller apparently has attacked the problem in an indirect way and this may lead to some interesting results.

In this connection, it seems to me there is an important point which should always be borne in mind. In considering the effects of radiation it is not the actual amount of energy falling upon the irradiated substance which is important, but, rather, the fraction of this amount which is effective in producing the observed change. For instance, when hard X-rays are used, most of the energy of the beam passes through the superficial layers of the material and can have no effect on it. Only the small amount which is absorbed is responsible directly or indirectly for the changes produced.

Applying this mode of reasoning to ionization measurements, it will be seen that the ionization chamber measures only the fraction of the radiation passing through it which is absorbed by the air in the chamber or is in some way effective in producing ions (for instance, by liberating high speed electrons from the walls of the chamber). In order to measure the total energy in an X-ray beam by means of an ionization chamber, the latter would have to be so large that the scheme becomes impractical.

But granting that by making certain assumptions one can calculate the energy in an X-ray beam, it does not seem to me that this information will help us materially in the correlation of radiation dose and biological effect produced. As already stated it is not the total energy of the beam that counts, but the part that is biologically effective. This varies with the wave length of the radiation. As a matter of fact, it is reasonable to expect a simpler relation between radiation and biological effect if the radiation is measured by a suitable ionization chamber, than by determining the total energy of the beam. In other words, the

ionizing effectiveness of a beam of rays is apt to be a good index of its biological effectiveness, irrespective of the wave length. However, this question cannot be settled *a priori* and has not been settled experimentally.

The best available information on this problem has been supplied by Packard's experiments in Dr. Wood's laboratory. It has been found there that equal amounts of X-rays produce the same effect on *Drosophila* eggs over a wide range of wave lengths. This result is definitely established, but I think we are not justified in assuming that the same result would be obtained with all other biological media. If this were the case then the same relation should also hold for the production of skin erythema with X-rays of different quality. According to some experiments, however, this is not the case.

In attempting to explain the apparent discrepancy, Wood points out that erythema is a very complicated reaction in which many different types of cell take part. Furthermore, scattered radiation, which is practically absent in the *Drosophila* experiments, plays an important part in the erythema experiments. It seems to me that this explanation is not wholly satisfactory. If we assume that the effect of radiation on all living cells is independent of the wave length, then skin erythema should also be independent of wave length. The pressure of scattered radiation cannot influence the result, *provided it is also included in the ionization measurement*, because it differs from the primary radiation only in quality. However, skin erythema involves many complications and I agree with Dr. Wood—although on different grounds—that such experiments are not in the same class as the *Drosophila* experiments.

DR. FRANCIS CARTER WOOD (New York): Perhaps Dr. Failla has left a false impression of my statement in which those

who are here might be interested. I meant to say that the process which occurs in a complex body made up of tissues of very different sensitivities, of extraordinary anatomical complexity, renders the discovery of the relationship between wave lengths and effect a very much more difficult matter than when you simplify it by using small groups of cells, such as tumor particles or fly eggs, and that that problem of the production of an erythema is a problem of clinical investigation because that erythema may very well be due to different quantities of energy with different wave lengths, because the erythema is a clinical reaction and not a pure biological phenomenon. Let us assume that the capillaries of the vessels are less damaged by short wave lengths than by long; each capillary cell may be damaged independently of the wave length, but the total reaction produced may be different. I do not think it is, and I am not prepared to make any dogmatic deductions from small groups of cells to large masses of cells which react in different ways. That is the condition of the problem.

DR. MUTSCHELLER (closing): I wish to refer to two points which I think have been brought out in the discussion. One is that this work has just been begun and that very much more work is to be done in order to be able to answer such questions as: "What is the definite relation between the total energy of the X-ray beam and the factors which can be measured now, namely, the energy of the quanta?" The second point, however, is that I think the effect upon the entire therapy problem which can be gained from a consideration of the radiation phenomena from the quantum point of view, will probably be to clarify many obscure propositions which, up to the present time, have not been readily visualized. I think Dr. Wood has referred to a number of such factors; and of those, we could in particular pick out one. What is really the difference in bio-

logical effect between what we call a low penetrating radiation, consisting of quanta that have a small amount of energy, and a highly penetrating radiation which consists of quanta possessing a large amount of energy? What is the difference between the two? I think Professor Glocker, in speculating in an entirely different manner, has arrived at a picture which is somewhat as follows: if we think of a cell as consisting of atoms, and atoms naturally as made up of electrons, we can imagine a radiation quantum possessing a large amount of energy as jumping from atom to atom, being stripped by each of a certain amount of energy which then remains in that atom, until it comes down to that stage where the quantum will finally be stopped. If such a quantum has a large amount of energy, it will jump through a very large number of atoms, and in that way leave a large amount of energy in that particular mass of cells or atoms. If, now, another quantum comes along—possibly across the path of the first one or following along the same track—it will also leave its energy with the various atoms, and finally there may have enough energy accumulated in the various atoms to cause the expulsion of an electron and therefore to cause ionization. The result would be a chemical effect which we actually do recognize, such as the coagulation of albu-

min or something of that sort. In other words, the total amount of energy of a highly penetrating quantum is distributed over as many atoms as are necessary to absorb all of its energy. In that way we can imagine that a highly penetrating radiation will then exert a very large biological effect, but only if there is a large mass of tissues. If we now think only of a few cells, such as a few *Drosophila* eggs in one plane, everything becomes simple and we immediately draw the conclusion that the biological effect on that layer of *Drosophila* eggs will be independent of the quantum energy or of the wave length.

Now I would just like to make this point, that I think the wave idea, to which we have clung up to the present, has explained many things, but has actually failed to explain a lot of other equally or more important things such as the scattering of X-rays and the specific effect of radiations of different wave lengths. But I think that if we now change over and think, for a little while, at least, in terms of the quantum idea, we may perhaps explain a lot of things and clarify and develop clearer and simpler aspects which will help very much more in the understanding of the biological relation of physical and biological factors in radiation therapy.

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## PARAVERTEBRAL ABSCESS

AN EARLY ROENTGEN SIGN OF TUBERCULOUS SPONDYLITIS<sup>1</sup>

By LEO G. RIGLER, M.D., WALTER H. UDE, M.D., and M. B. HANSON, M.D.

University of Minnesota, MINNEAPOLIS, MINNESOTA

THE percentage of cases of spinal tuberculosis which are accompanied by a paravertebral abscess has been variously estimated at from 20 to 100 per cent. Careful postmortem studies indicate the presence of abscess in about 80 per cent of the cases of thoracic spine tuberculosis,

best premortem figures are those of Sgalitzer (3), who was able to detect abscesses roentgenographically in 66 per cent of his cases with thoracic spine involvement.

The importance of the roentgen diagnosis of paravertebral abscess is well recognized and is emphasized in all standard books on

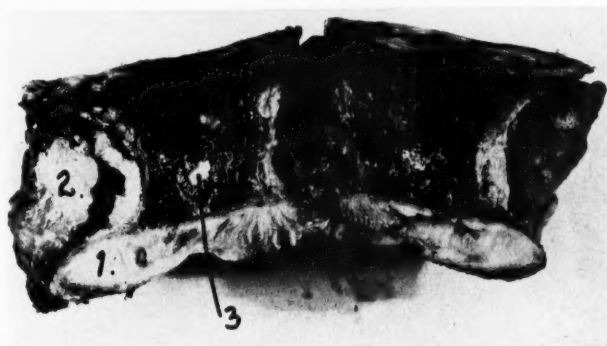


Fig. 1. Photograph of sagittal section of a vertebral body from a case of tuberculous spondylitis. Note the central caseation (3), the deep erosion of the centers of the anterior surface of the bodies (2), the comparatively moderate narrowing of the intervertebral disc (1), and the absence of compression of the body of the vertebra.

with considerably less frequency in the other portions of the spine. The clinical recognition of abscess is in many cases difficult, and Whitman (1) quotes various studies to indicate its detection by clinical means in approximately 20 per cent of all cases. Steindler (2) by both clinical and roentgen methods found abscess in 30 per cent of all his cases of spinal tuberculosis and in 45 per cent of the thoracic spine cases. The

orthopedic surgery and roentgen diagnosis. It is important in establishing definitely a diagnosis of spinal tuberculosis, in determining the limits of the disease, and in evaluating the progress and prognosis of the particular case. The presence of abscess, however, is usually considered to be confirmatory of the diagnosis previously established by the clinical findings and the roentgenographic evidence of involvement of the vertebral bodies and intervertebral discs. Because the characteristic shadow of an abscess about the spine is almost pathognomonic

<sup>1</sup>From the Departments of Roentgenology of the University of Minnesota, the University Hospital, the Minneapolis General Hospital, and the Lymanhurst School for Tuberculous Children, Minneapolis, Minn.

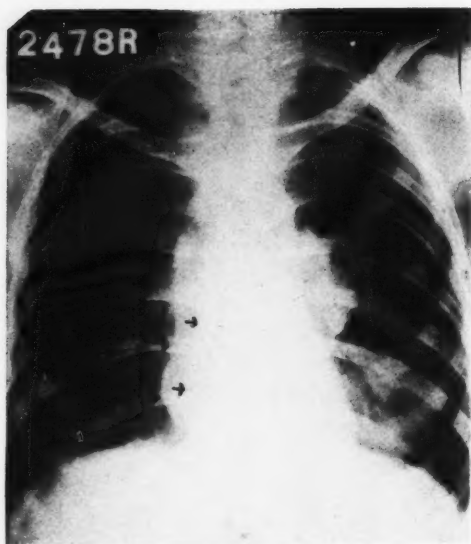


Fig. 2. Postero-anterior roentgenogram of the chest of Case 1. Note the large shadow (indicated by the outer arrows) of the abscess superimposed upon the heart and large vessels. The abscess is exaggerated in size because of its distance from the film. The inner arrows on the right indicate the cardiac outline.

of tuberculosis it serves to clinch the diagnosis when the character of the vertebral change may leave some doubt. It is true that osteomyelitis may give a somewhat similar appearance but this is the only exception.

That the roentgen diagnosis of paravertebral abscess may be the first positive evidence of spinal tuberculosis and may clearly precede any visible changes in the spine itself is not so generally recognized. Such recent works on the spine as those by Steindler (2) and George and Leonard (4) make no mention of this fact and its importance is generally overlooked. Sgalitzer (3), in 1919, was probably the first to call attention to this interesting phenomenon, and in a recent article (5) he reports a number of cases of this type. Hass (6) also noted that roentgenographic signs of paravertebral abscess might precede similar signs in the spine itself. Sever (7), in empha-

sizing the importance of the visualization of an abscess in the diagnosis of spinal tuberculosis, noted that "perivertebral thickening" might precede the visible bone changes. Erdheim (8) has repeatedly observed at autopsy the presence of paravertebral abscesses which directed attention to the spine. The latter in these cases might be grossly normal with no gibbus, no collapse or obvious destruction of the vertebral body, and no narrowing of the intervertebral disc. On section, however, very small central caseous areas of tuberculosis were found, which no doubt served as foci for the abscess. These central foci are frequently multiple, but when single and very small it is not surprising that they may be quite invisible in the roentgenogram.

Willis (9) in a roentgen and anatomical study upon the cadaver reported several cases in which he found a large thoracic abscess without any changes in the vertebra which could be seen in the antero-posterior roentgenogram. In the lateral view, however, some erosion of the anterior surfaces of the bodies could be made out, but this was clearly due to pressure from the abscess. In these cases no narrowing of the disc and no angulation was present. Figure 1 is a photograph of a sagittal section of a vertebral body loaned from the Department of Pathology of the University of Minnesota. It illustrates aptly this type of case, as it shows the central area of caseation (3), the erosion of the anterior surface of the spine by the massive paravertebral abscess (2), which was present, the comparative lack of narrowing of the intervertebral disc (1), and the absence of collapse of the body of the vertebra. Ghormley and Bradley (10) have described this "aneurysmal" erosion of the bodies of the vertebrae, which is clearly due to pressure from the abscess.

Sgalitzer (5) believes that those cases in which there is a definite paravertebral abscess without visible changes in the spine may represent a very early stage of tubercu-

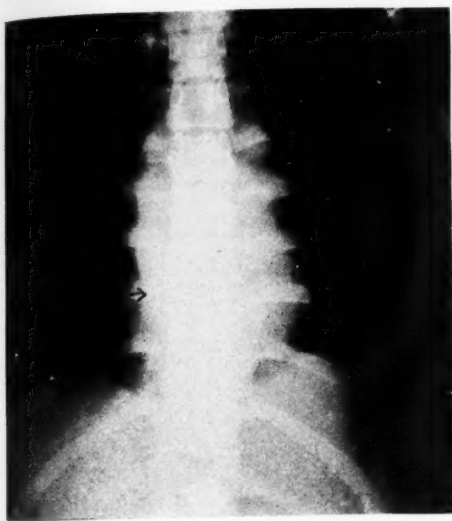


Fig. 3-A. An antero-posterior roentgenogram of the spine in Case 1. The typical, irregular, bilateral, fusiform-shaped abscess shadow is outlined by the arrows. Note the normal appearing vertebrae.

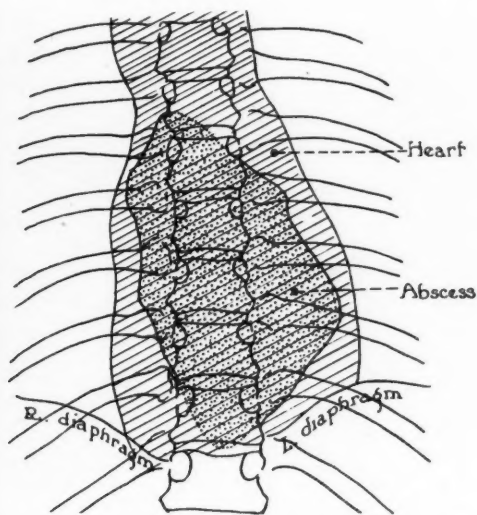


Fig. 3-B. Drawing from a tracing of Figure 3-A.

lous spondylitis. If followed for a period of time, definite bone and cartilaginous changes will appear. Another group may represent a very benign form of tuberculous spondylitis which fails to break down sufficiently to invade the intervertebral disc or to produce the typical collapse of the vertebral body.

The early recognition and differentiation of paravertebral abscess from other conditions is obviously a matter of some importance. As has been stated, they are most common in the thoracic region. They may also occur in the cervical region, while in the lumbar region psoas abscess is more frequent. The roentgenographic characteristics of the latter have been fully described by Kloiber (11), Sgalitzer (5), Schmid (12), Pitzen (13), Ghormley (14), and Massart and Ducroquet (15) give excellent and detailed descriptions of the appearance of paravertebral abscess. It is sufficient here to note the spindle-shaped form, symmetrical

bilateral appearance, and slight irregularity of the margins of the shadow about the spine. These findings are well illustrated in Figures 3-A and 3-B, which represent the abscess in the antero-posterior view. Very little of the abscess shadow can be seen in the lateral view. The esophagus and trachea may be displaced anteriorly if the abscess is large. Usually it tends to extend down to the diaphragm first and then may attempt to rupture outside the usual boundaries.

It is notable that the shadow of the abscess may be lost in that of the heart, as Dubrow (16) has pointed out, and if postero-anterior films of the chest are made it may give the appearance of a bilateral mediastinal effusion. This is well illustrated in Figure 2 and was also present in our second case. The superimposition of the shadows of the various chambers of the heart, the descending aorta, the other large vessels, the paravertebral muscle shadows, and the reflection of the posterior medias-



Fig. 4. Lateral roentgenogram of the spine in Case 1. Note the very slight erosion of the anterior surfaces of the bodies of the seventh and eighth thoracic vertebrae. There is no destruction in the bodies and no narrowing of the intervertebral disc.

tinal pleura all serve to make the diagnosis difficult. The bilateral character of the paravertebral abscess shadow and its characteristic spindle-shape are the most important differential factors. Osteomyelitic abscess usually gives more pronounced findings in the spine itself and a very different clinical history. Mediastinal pleurisy, enlarged thymus and other mediastinal tumors, aneurysm of the aorta, and abscess from the ribs or sternum must be ruled out. It should again be emphasized that small abscesses are easily overlooked.

We have observed four cases of tuberculous spondylitis, in two of which the paravertebral abscess was the first roentgen sign, preceding visible bone changes. In the other two the findings in the vertebral column it-

self, although visible, were comparatively minimal, while the abscesses were large and characteristic.

#### CASE REPORTS

Case 1. White female, aged 32, admitted to the medical service of the Minneapolis General Hospital because of weakness, fatigue, diarrhea, blood in stools, and swelling of the ankles. Has had pulmonary tuberculosis diagnosed four years previous to present admission. Pains in back have been present for nine years. Diarrhea and intermittent temperature have been present for six months, following a pelvic operation.

Physical examination revealed marked emaciation, general anasarca, anemia, and a low blood pressure. There was an area of dullness over the left thorax posteriorly. The abdomen was distended, with fluid in the flanks. There was little or no pain on percussion of the spine.

The urine, blood, and clinical picture indicated a toxic nephrosis or amyloidosis of the kidney.

Roentgen examination of the chest (Fig. 2) revealed some calcified tuberculous nodules in the right apex, but no evidence of recent or active tuberculosis. A large shadow extending beyond the borders of the heart on both sides was also present. Its irregular character and bilateral distribution suggested a paravertebral abscess which had become grossly exaggerated in size because of the usual postero-anterior chest position. Films of the thoracic spine made in the antero-posterior position showed a marked reduction in size of the shadow, which presented the classical picture of paravertebral abscess (Figs. 3-A and 3-B). No abnormal changes in the vertebrae could be made out. A lateral view (Fig. 4) showed some slight erosion on the anterior surfaces of the bodies of the seventh and eighth thoracic vertebrae but the intervertebral discs



Fig. 5-A. Antero-posterior roentgenogram of the spine in Case 2. Note the large, bilateral, somewhat rounded abscess shadow outlined by arrows. The vertebrae appear normal.

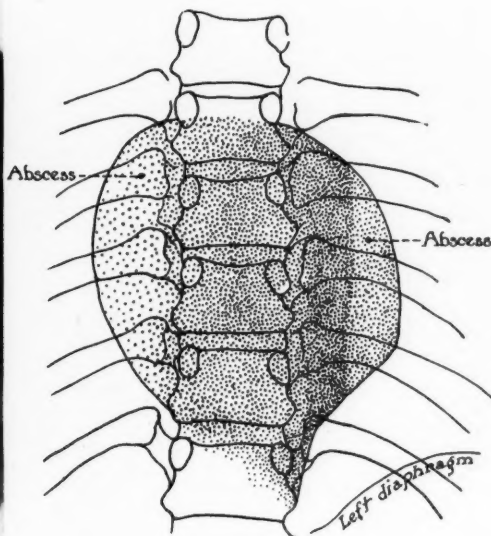


Fig. 5-B. Drawing from a tracing of Figure 5-A.

were not narrowed and there was no destruction within the bodies of the vertebrae. The slight changes on the anterior surface may be interpreted as due to pressure from the abscess.

Postmortem examination by Dr. C. J. Watson gave the following pertinent findings: (1) Chronic pulmonary tuberculosis, fibroid and calcified right apex; (2) amyloidosis of spleen, kidneys, and liver; (3) tuberculosis of the right kidney and left adrenal; (4) tuberculosis of the ilium; (5) a large "cold" abscess about the seventh and eighth thoracic vertebrae extending well above and below this level and along the ribs. The abscess extended somewhat into the intervertebral joint between the seventh and eighth thoracic vertebrae and eroded their anterior surfaces. It appeared to arise from within the bodies of the seventh and

eighth thoracic vertebrae, but the changes in the bodies themselves were minimal.

Case 2. White male, aged 14, was referred to the Out-patient Department of the Lymanhurst School for Tuberculous Children because of malnutrition and as a tuberculosis suspect. Symptoms were negligible but the temperature varied from 99.2° to 100°. Physical examination showed only a scoliosis of the thoracic spine but was otherwise negative. The Von Pirquet and Mantoux skin tests were slightly positive.

A roentgenogram of the chest was made and a shadow in the region of the seventh to the ninth thoracic vertebrae could be made out, superimposed upon the heart shadow and lying within it. The appearance suggested a paravertebral abscess. An antero-posterior roentgenogram of the thoracic spine showed the typical appearance of a paravertebral abscess (Figs. 5-A and 5-B)





Fig. 6. Lateral roentgenogram of the spine in Case 2. Note the lack of visibility of the abscess and the normal vertebrae of a growing child.

but in the lateral view (Fig. 6) no evidence whatever of tuberculosis of the vertebral bodies or intervertebral discs could be seen. Nevertheless a diagnosis of tuberculous spondylitis was made.

Four months later a re-examination of the thoracic vertebrae was made. This showed slight destruction of the anterior and inferior portions of the sixth vertebral body which was fairly typical of tuberculosis.

Case 3. White male, aged 45, was admitted to the neurological service of the University Hospital complaining of difficulty in walking, loss of sensation in the lower extremities, staggering in the dark, gas distention, and constipation. He had suffered some pain in the back several months before, which had been relieved by "light treatments." The neurological symptoms had appeared during the past few months.

Physical examination revealed some evi-

dences of paraplegia involving the lower extremities, but no other significant findings. The temperature ranged from  $99.0^{\circ}$  to  $100^{\circ}$  in the afternoon until he developed a pleural effusion, when it rose to  $102.2^{\circ}$ .

Roentgen examination of the whole spine revealed a characteristic, irregular, spindle-shaped shadow in the thoracic region extending from the seventh to the ninth vertebrae, typical of paravertebral abscess (Figs. 7-A and 7-B). In the lateral view (Fig. 9) the eighth and ninth bodies showed a slight mottling, indicating a destructive process, but there was very little narrowing of the intervertebral disc. The eleventh thoracic vertebra also showed some loss of density. A roentgen diagnosis of tuberculosis of the eighth, ninth, and eleventh thoracic vertebrae, with paravertebral abscess, was made.

Roentgen examination of the chest was negative. Later the patient developed a pleural effusion, which, however, was negative on guinea pig inoculation.

He was transferred to Glen Lake Sanatorium, where the paraplegia has gradually disappeared and he has made slow but satisfactory progress.

Case 4. White female, aged 32, was admitted to the medical service of the Minneapolis General Hospital complaining of pain in the lumbar region and pleurisy pains. These had followed an abortion eight weeks previously. The pain had become worse and was aggravated by bodily movements and deep inspiration.

Physical examination revealed tenderness over both kidney regions, most marked on the right under the costal margin. There were no other essential findings.

Roentgenographic examination of the lower thoracic and lumbar spine showed a small spindle-shaped bilateral shadow, about the bodies of the seventh to the tenth thoracic vertebrae (Fig. 9). This was characteristic of paravertebral abscess. In the lateral view (Fig. 10) there was some evidence of narrowing of the intervertebral

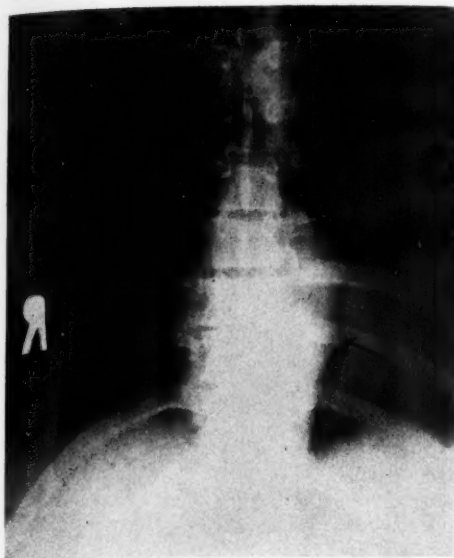


Fig. 7-A. Antero-posterior roentgenogram of the spine in Case 3. The large very irregular abscess shadow is seen extending down to the diaphragm on the left. Slight decalcification of the bodies of the ninth and tenth thoracic vertebrae, together with narrowing of their intervertebral disc, is shown.

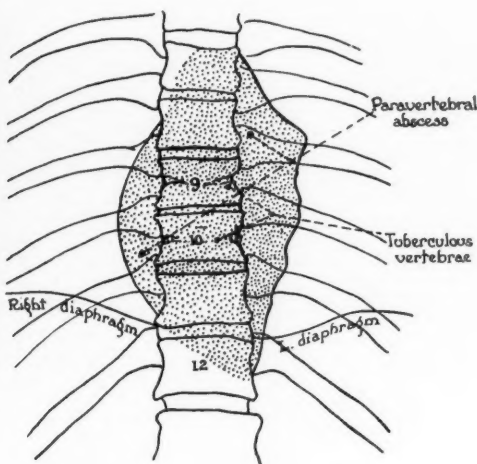


Fig. 7-B. Drawing from a tracing of Figure 7-A. Note the slight changes present in the ninth and tenth vertebrae and the intervertebral disc.

disc between the ninth and tenth thoracic vertebrae, with slight erosion of the articular surface of the ninth. A roentgen diagnosis of tuberculosis of the ninth and tenth thoracic vertebrae, with paravertebral abscess, was made.

#### COMMENT

The first two cases illustrate aptly the appearance of a paravertebral abscess in the ordinary postero-anterior chest film and the accidental discovery of this condition which was clinically unsuspected. The lack of roentgenographic findings in the spine is obvious and the large, definite, abscess shadow was the first evidence of tuberculous spondylitis either clinically or roentgenologically. The first case was confirmed by autopsy, while the eventual course in the second indicated clearly the presence of tuberculosis of the vertebrae. In Case 2, especial-

ly, the roentgen observation of the abscess made possible a very early diagnosis.

Cases 3 and 4 illustrate the importance of the roentgen demonstration of paravertebral abscess as a diagnostic sign of early tuberculous spondylitis, as the roentgenographic findings in the vertebrae themselves in either case are not entirely characteristic. The multiplicity of involvement in Case 3, for example, led to a clinical diagnosis of possible metastases rather than tuberculosis.

#### SUMMARY AND CONCLUSIONS

Paravertebral abscess occurs very commonly in tuberculosis of the thoracic vertebrae but is clinically unrecognized in many cases.

Its roentgen diagnosis is important because it is almost pathognomonic of tuberculous spondylitis.

It may be the earliest roentgen sign of



Fig. 8. Lateral roentgenogram of the spine in Case 3. Note the mottled appearance of the ninth and tenth thoracic vertebrae resembling metastases. The narrowing of the ninth intervertebral cartilage is slight but definite.

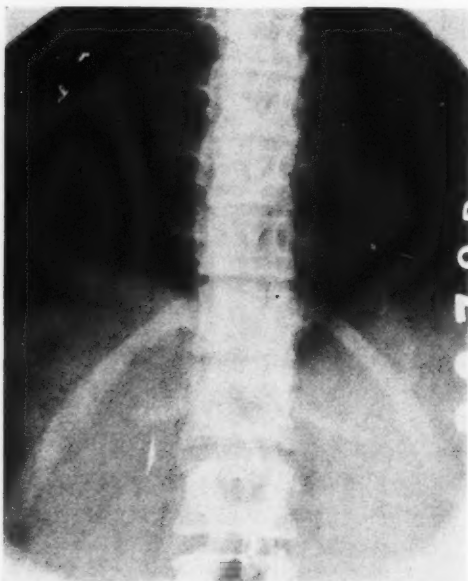


Fig. 9. Antero-posterior roentgenogram of the spine in Case 4. Note the small abscess just above the diaphragm and the barely perceptible changes in the bodies of the ninth and tenth thoracic vertebrae.



Fig. 10. Lateral roentgenogram of the spine in Case 4. Note the slight narrowing of the ninth intervertebral cartilage and the rarefaction of the posterior portion of the ninth vertebral body.

tuberculous spondylitis appearing before there are any visible changes in the bodies of the vertebrae. Two cases of this type are reported.

It may be present in characteristic form while the changes in the vertebral column are still minimal or not entirely diagnostic roentgenographically. Two cases of this type are reported.

Paravertebral abscess may overlap the shadow of the heart in the ordinary chest roentgenogram, simulating a mediastinal process.

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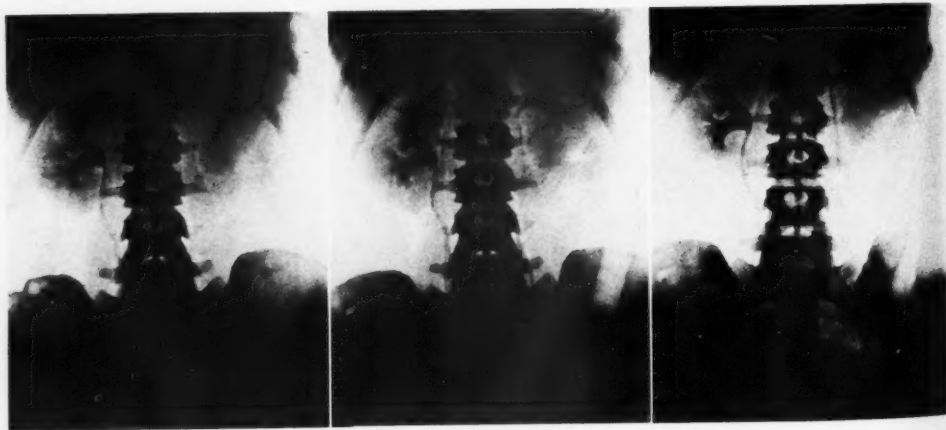
## UROGRAPHY BY UROSELECTAN

By I. SETH HIRSCH, M.D.

THE story of excretion urography really begins with the work of Rowntree and his associates, who in 1923 used sodium iodide intravenously for this purpose. They proved that intravenous urography was possible, feasible, and practical, if the proper chemical could be found. Several years later Roseno was able to show the urinary passages by the administration of a urea-iodine preparation, and though Ziegler and Köhler improved the visualization by external compression of the ureters, the radiographic contrast was not sufficiently graphic. Besides this, the substance was not well tolerated and was eliminated slowly.

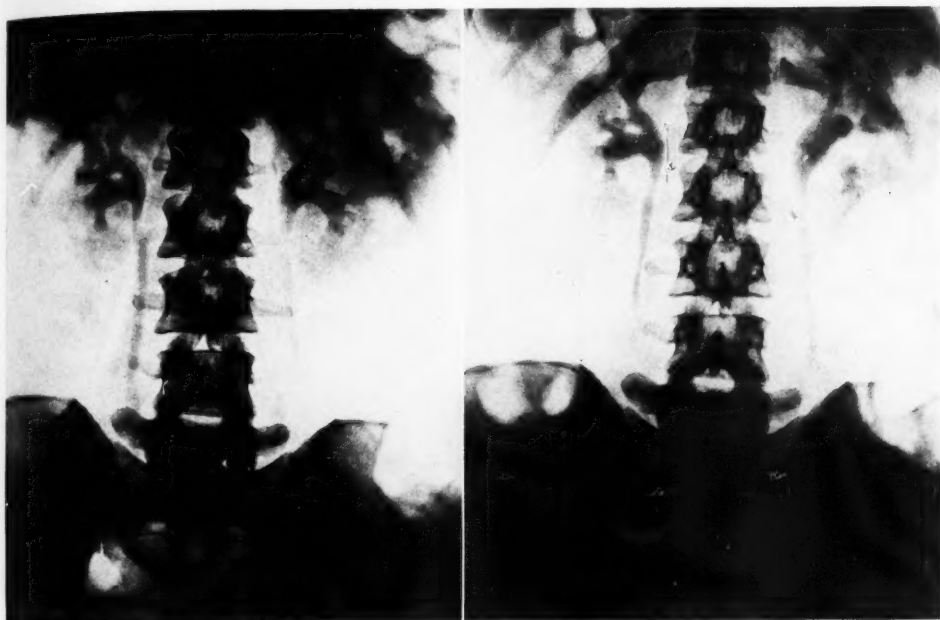
The development of uroselectan as a contrast substance for intravenous urography is indirectly the result of research in the direction of obtaining a contrast medium for cholecystography. A substance called Selectan-Neutral, introduced by Bintz and

Räth, which for some time had been in use as a therapeutic agent in infections of the biliary tract was investigated (because of its high iodine content of 54 per cent) as to whether or not it could be used for cholecystography. Though the biliary tract was not clearly outlined by this preparation, the urinary tract was so clearly demonstrated that experiments were undertaken by M. Swick, of New York, in the Clinic of Lichtwitz (Hamburg), with the view to making this drug applicable to urography. Swick found that 0.2 gram of Selectan-Neutral per kilogram of body weight was easily tolerated, and that as much as 18 grams of the substance could be administered without deleterious effects to a subject weighing 60 kilos. The kidney and bladder shadows were sufficiently distinct to indicate the possibilities of the method. However, whether the drug was administered by mouth or in-



Figs 1-A, 1-B, and 1-C. Illustrating the variations in appearance of urograms at first, second, and third examinations, made at intervals of twenty minutes. Fig. 1-A was made twenty minutes after injection; Fig. 1-B, forty minutes after injection; Fig. 1-C, sixty minutes after injection. The ureter on the left side shows marked hypertonicity. The right kidney is lower than the left. The urinary tract is morphologically normal. Function is normal on both sides.





Figs. 2-A and 2-B. Illustrating the variation in appearance of the urogram at second (Fig. 2-A) and third (Fig. 2-B) examinations. In Figure 2-B the ureters are in systole and in peristalsis. Function is normal, and the urinary tract is morphologically normal.

travenously, there was headache, nausea, and vomiting.

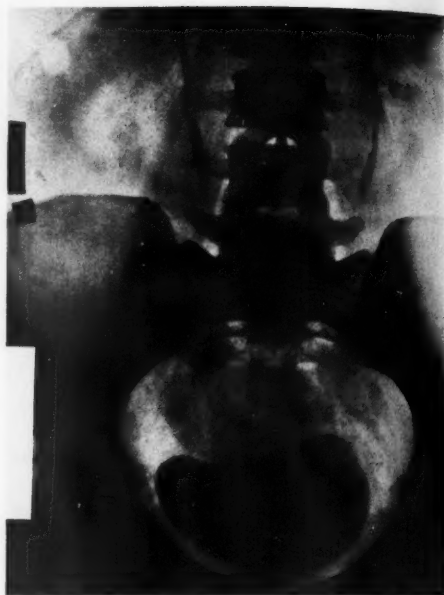
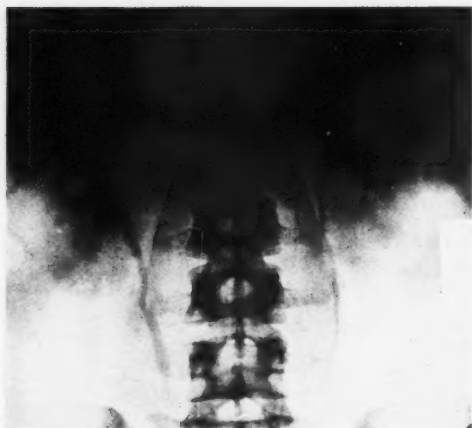
It was apparent, therefore, that a modification of the preparation was necessary in order to so diminish its toxicity that larger quantities might be tolerated and a higher concentration obtained in the urine.

The removal of the methyl group diminished the toxicity and increased the solubility of the compound. Its iodine content was somewhat lowered, however.

This preparation, uroselectan, has been perfected by the chemists, Bintz and R  th. It fulfills all the requirements. It is non-toxic, easily soluble in water, and is excreted by the kidney in a concentration high enough to give the necessary roentgenologic contrast. The iodine content of 42 per cent exists in a stable, organically combined

form. Under normal conditions, uroselectan is excreted as such to the extent of from 90 to 100 per cent through the urinary tract within eight hours, suggesting that probably no chemical reaction takes place in the body. The iodine component cannot be recovered in the blood. Neither in solution nor in its excreted form is the iodine present in an inorganic, ionized state. Because of this, in spite of the relatively large quantity of the calculated iodine element in uroselectan, it can be administered with impunity. Iodism has never been observed.

The method is based on the excretion of the contrast substance by the kidneys. The more normal the kidneys, the greater the excretion, and the earlier, the more constant and complete is the delineation of the urinary tract. Since about 90 per cent or more of the iodine content can be recovered



Figs. 3-A (*above*) and 3-B (*right*). In this case instrumental pyelography showed an aberrant upper calyx on the right side. A urogram made by the intravenous method showed a similar condition on both sides. Function was normal.

in the urine within from six to eight hours, in cases with normal kidney function, uroselectan becomes a test of renal function in addition to a urographic medium. This method may, therefore, be called "excretion urography" in contradistinction to "instrumental urography."

Urography with uroselectan permits: (1) visualization of the urinary tract; (2) the study of the physiology of the urinary tract; (3) the determination of kidney function.

The urinary tract as outlined by contrast substances has never really been studied under normal conditions in the living until the advent of this remarkable method. Instrumental urography, necessitating the introduction of catheters and fluids under more or less pressure, distorts and obliterates normal anatomic characteristics and relationships.

The lack of uniformity in the morphologic characteristics of the ureter is one of the striking features which this examination has disclosed. Loopings, bendings,

narrows, dilatations, and marked deviations in position, are very common findings.

Intravenous urography shows for the first time the physiological functional variations and permits the study of tone and peristalsis of the ureter and pelvis of the kidney.

The criteria for diagnosis will be considerably amplified and elaborated by this method. Contrasted filling of the urinary tract is obtained when the particular part is in diastole: those portions of the ureters for the moment in systolic contraction are poorly visualized.

The conclusions regarding disturbed function are based on the time of visualization of the contrast substance and the degree of density of the shadow. The actual standard of density is arbitrary and depends on a comparison of the two sides and the general structural density as shown in the roentgenogram.

Sharp and clear visualization may be expected only when the kidney function is normal. Depending on the degree of parenchymal damage, there is poor or delayed or



Fig. 4. Urogram showing marked bending of right upper ureter; size and tonus normal; peristalsis normal. Ureters outlined to vesical junction; function normal.



Fig. 5. Urogram showing right hydronephrosis and marked tortuosity of dilated right ureter. Tone not lost. Peristalsis could be visualized. The left urinary tract was normal, as was function on both sides.

no visualization whatever. If there is no outlining of the pelvis and calices, it is either because there is no kidney or the function has been destroyed. Thus renal tumor, severe infection, and pyonephrosis give no visualization, while malformations in which function is maintained are clearly delineated. According to von Lichtenberg and Swick, general lowering of the functional efficiency of the system, as in severe cardiac failure, may be responsible for non-visualization; nor was visualization obtained in some cases of peripheral urinary stagnation, with infection. In a case of almost complete urinary obstruction by stone and infection, there was, at first, no visualization; but when, fourteen days later, the infection had partially subsided, the tract was well outlined. In cases in which there is no

infection, as in hydronephrosis, good visualization is obtained.

#### INDICATIONS FOR INTRAVENOUS UROGRAPHY

1. In cases in which anatomical and pathological obstacles exist for cystoscopy, ureteral catheterization, or instrumental pyelography.

2. In cases in which there is ureteral obstruction and the pyelographic solution cannot be injected beyond the obstruction.

3. In cases in which instrumental pyelography is definitely contra-indicated or not convenient.

Intravenous urography should be used in those cases in which cystoscopy and ureteral catheterization are difficult or impossible, namely:

- (a) In urethral strictures, severe bladder disease, and severe bleeding.



Fig. 6. Urogram showing enlarged hydronephrotic kidney on right side. On left side no kidney function; no visualization.

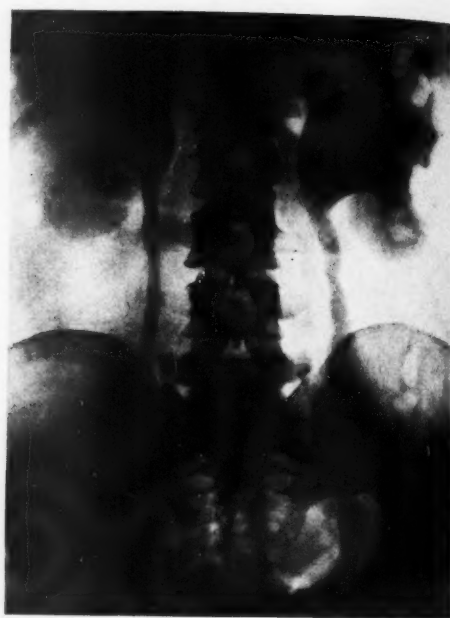


Fig. 7. Urogram showing marked dilatation of pelvis and calices on right side; hydronephrosis; dilatation of ureter. On the left side similar conditions existed in a lesser degree. Function on both sides was normal.

(b) In cases in which the ureters cannot be catheterized and in which catheterization gives no definite information; in cases of ruptured kidney; in fistulae; in cases in which the ureters have been transplanted.

(c) In those cases in which instrumental pyelography should not be done—in acute and chronic disease of the adnexa, in tuberculosis, in cases of prostatic hypertrophy.

(d) In infants and children.

#### TECHNIC OF INTRAVENOUS UROGRAPHY

The technic of intravenous urography is extremely simple. The drug uroselectan is a powder put up commercially in forty-gram packages. The forty grams are completely dissolved by gradually adding it to 80 c.c. of previously heated, double distilled water. The volume is then made up to 110 cubic centimeters. It is filtered twice and

then sterilized by heating it over a steam bath for twenty minutes. The solution, cooled to body temperature, should have a volume of 110 cubic centimeters. For obese patients, 60 grams are necessary. Three packages are then dissolved in 220 c.c. of water, and 110 c.c. of the solution is used for a case. When cooled, the 110 c.c. is injected intravenously in two parts, with a syringe, allowing a brief interval between injections. The injection is made in the X-ray department by a member of the department's staff. The simple procedure of the injection needs no elaboration. The patient has a sensation of warmth, particularly over the face and vesical regions. The subjective sensations are not at all uncomfortable—it is only to avoid any possible discomfort that the solution is injected in two parts. There is, however, no objec-

tion to injecting the entire 110 c.c. at one time. There are no after-effects whatever. After the radiographs have been made, the patient may resume his usual routine. The methods of oral and rectal administration give results inferior to those which may be obtained when the drug is administered intravenously.

The preparation of the patient is the same as for the usual roentgen examination of the urinary tract. The bladder is emptied and a preliminary roentgen examination is made before the uroselectan is injected.

Though the concentration of uroselectan in the urine varies, it is usually about 5 per cent. The roentgenograms, even in normal cases, have not, therefore, the photographic contrast obtainable with solutions in use for instrumental pyelography. In cases in which there is kidney damage, this contrast is still further diminished. A slight modification of the X-ray technic may, therefore, be necessary for good contrast.

The technic includes the customary immobilization, the use of the grid, and the usual urinary tract "set-up." The routine  $14 \times 17$  film should be supplemented by separate films of either or both kidneys, and the lower portion of the tract. Compression with the inflated bag or loofah sponge may be applied a short time before the exposures are made, though this is by no means essential. The roentgen study is a serial one.

The first urogram may be made fifteen to twenty minutes after the injection and a second exposure fifteen to twenty minutes later. The patient should be permitted to void after the second exposure. The withholding of urination over a long period is not necessary. Overdistention of the bladder hides the lower portion of the ureters. Three subsequent urograms may be made at intervals of fifteen to twenty minutes, making a total of five in all. If the visualization of the entire urinary tract on both sides

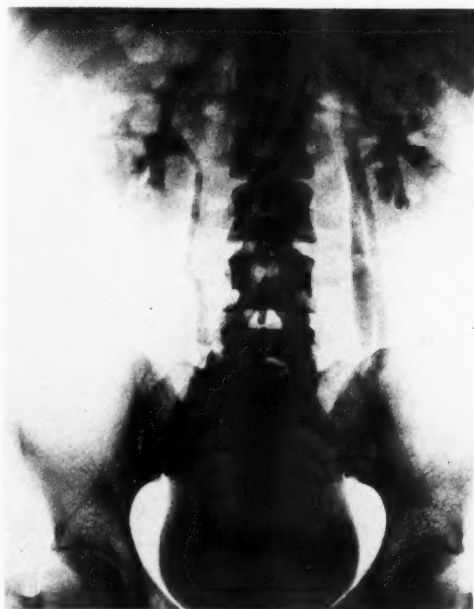


Fig. 8. Urogram showing double kidney and ureter on right side, the ureters fusing at a point about four inches above the bladder junction. The left side is normal. Function of the three kidneys is normal.

is clear and definite in the first or in the second film, this may be considered sufficient, and the examination be called complete. If, however, there is no visualization at first, it is necessary to make the entire set of five films.

In cases in which there is considerable renal dysfunction, clear visualization may not be obtainable until from six to twenty-four hours have elapsed.

It would appear that in actual practical work, three exposures, the first at fifteen, the second at forty-five, and the third at seventy-five minutes after the injection, will suffice.

The period of maximum visualization may be determined by fluoroscopic examination. Within five minutes after the injection the contrast substance may be vis-



ualized in the kidney, but the tract in its entirety cannot be visualized before twenty minutes have elapsed.

This new method widens to a considerable degree the scope of the roentgenologist's function in urology. He is no longer dependent on the urologist for the instrumental procedure which was previously essential for urography. The roentgenologist now has at his command a safe and simple method for studying the urinary tract in countless medical and surgical cases in which the symptoms are not of sufficient

gravity to indicate instrumentation and in which instrumentation is contra-indicated.

Intravenous urography will undoubtedly solve many urological problems without the aid of cystoscopy and ureteral catheterization, and will probably replace catheter pyelography as the method of choice. It will not replace the catheter for the determination of the source of blood and pus, nor for the segregation of the kidney urine. It may attain the status of a renal function test, but it will not do away with ureteral catheterization entirely.

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## A CONCEPT OF ARTHRITIS<sup>1</sup>

By LAURENCE H. MAYERS, M.D., CHICAGO

OUT of the great wilderness of pain the word "rheumatism" was born.

It conveys an idea: it is not a diagnosis. Fortunately, it satisfies the less exacting laymen, but, unfortunately, too many members of our profession frequently submit it as a diagnosis to obviate a painstaking

In our thinking concerning chronic infective arthritis, we are not far removed from the idea of the King's touch. It was only in 1907 that Nichols and Richardson, finding interest in the subject of arthritis from a pathological viewpoint, produced a series of observations which have remained clas-



Fig. 1. Streptococcal erysipelas of the face.



Fig. 2. Lupus vulgaris of the face.



Fig. 3. Syphilis, papulosum lenticularis.

ing and skillful examination. "Rheumatism" is the refuge of careless doctors, who frequently learn too late that pain is a symptom of malignancy. Joint troubles are inevitable when joint conditions become chronic. From this fact there has developed a bewildering nomenclature, irrational ideas of etiology, confusing attempts at pathological classifications, and a mass of therapeutic hodge-podge, unrivalled by any disease except tuberculosis. When pulmonary tuberculosis was "consumption," glandular tuberculosis was "King's evil," and joint tuberculosis was "white swelling." Miasma was the cause and the King's touch the cure.

sical in their description, and for a long time to come will form the basis upon which the condition is studied. They were not interested in the treatment, but they did reach the conclusion that, whether or not it was hypertrophic, atrophic, or mixed in character, all manifestations were infectious in origin, and were probably caused by the same organisms.

The number of classifications of arthritis is almost as numerous as the number of men who have made a study of the condition. We claim nothing new, other than perhaps our approach to the practical business of diagnosing and treating arthritic conditions. We accept the classifications made by various workers as correct.

<sup>1</sup>Read before the Radiological Society of North America at the Fifteenth Annual Meeting, at Toronto, Dec. 2-6, 1929.



Fig. 4. Erysipelas perstans.

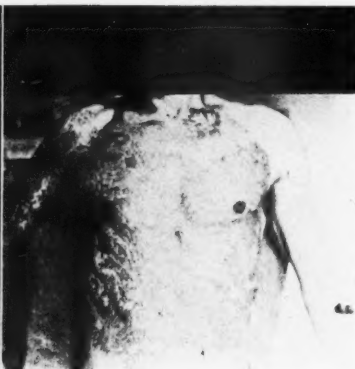


Fig. 5. Lupus vulgaris.

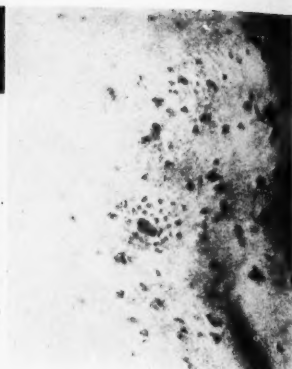


Fig. 6. Syphilis papulosa.

When studying and treating chronic diseases we must be cautious in arriving at conclusions. We must keep in mind that there are but few healthy persons, and as investigators of particular conditions we must not be misled by our findings. Many obscure factors enter into the cause of disease, which, though obscure, may be very real. Identity of lesion does not signify identity of cause, and there are some peculiar facts unexplained in symbiotic relationships.

The streptococcus causes many diseases and sometimes causes the train of symptoms and physical findings designated as arthritis. One may say that a patient suffering with a chronic streptococcal infection becomes physiologically old, regardless of age. Joint lesions, especially cartilagenous lesions, may have relatively slight power of repair, and

with any method of actual cure, the functional restoration is impossible. The pathology of streptococcal infected tissue tends to progress, with long periods of remission. Many enthusiastic claims of cures in reality but represent these remissions.

The history of a typical arthritic patient frequently does not give a clue to the focus of infection. Inasmuch as the loss of immunity to streptococcus carries with it a loss of immunity to many potentially pathogenic inhabitants of the upper respiratory passages, the identification of the focus is frequently obscure and sometimes impossible, as a result of allied infection. Chronic infective arthritis may be defined as a chronic disease, caused by infection from various strains of bacteria. Usually it is a streptococcus infection. The general symptoms are



Fig. 7. Purpura hæmorrhagica.



Fig. 8. Tuberculotoxin.

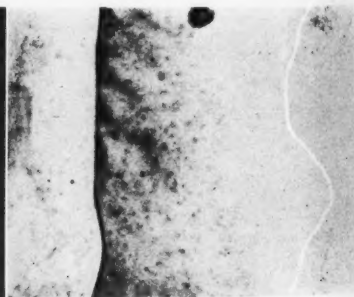


Fig. 9. Syphilis maculosa.

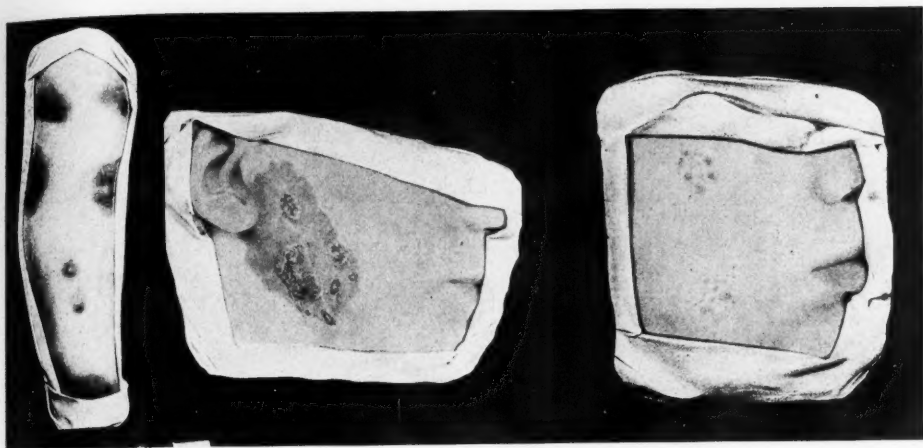


Fig. 10. Purpura haemorrhagica.

Fig. 11. Lupus vulgaris

Fig. 12. Syphilitic lesions of face.

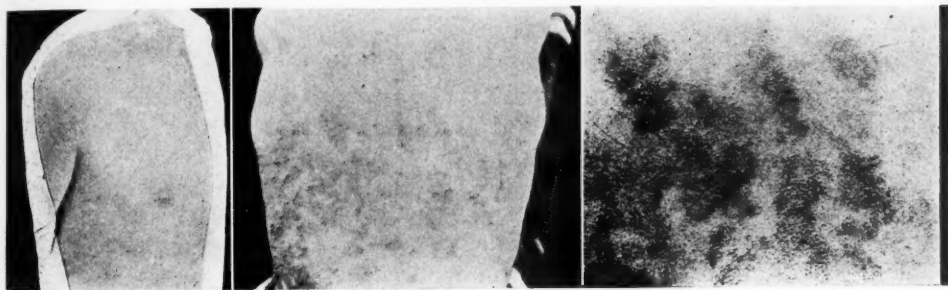


Fig. 13. Scarlet fever.

Fig. 14. Tuberculous toxemia of skin.

Fig. 15. Syphilis.

toxemia, fatigue, physical and mental depression. The pathological changes are progressive disturbances of muscles, nerve sheaths, articular, and peri-articular struc-

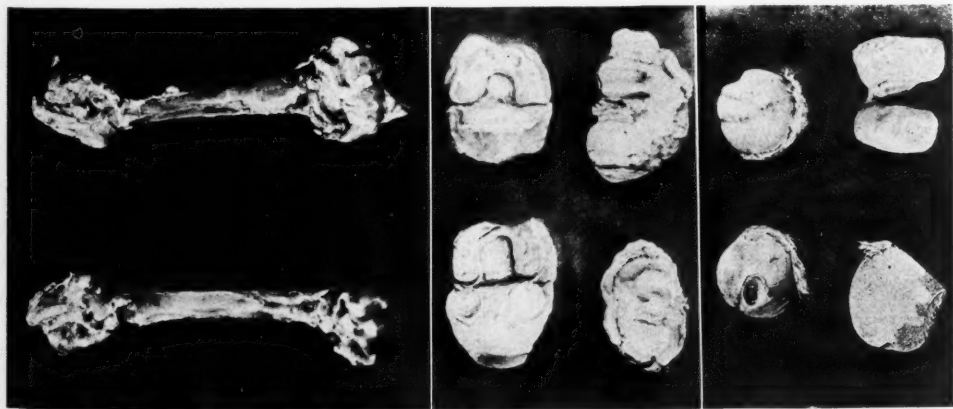


Fig. 16. Acute streptococcal infection, arthritis.

Fig. 17. Acute proliferative arthritis, streptococcal.

Fig. 18. Degenerative arthritis, due to syphilis.

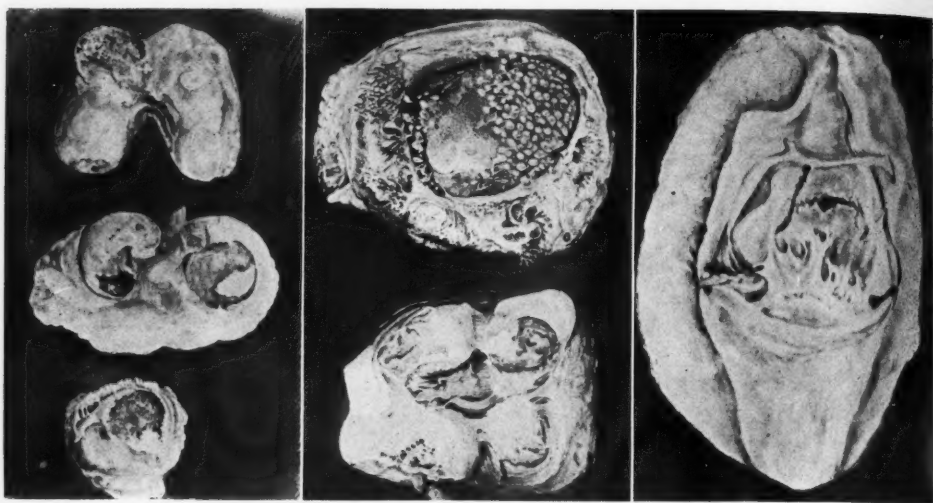


Fig. 19. Proliferative arthritis. Fig. 20. Advanced proliferative arthritis. Fig. 21. Arthritis deformans.

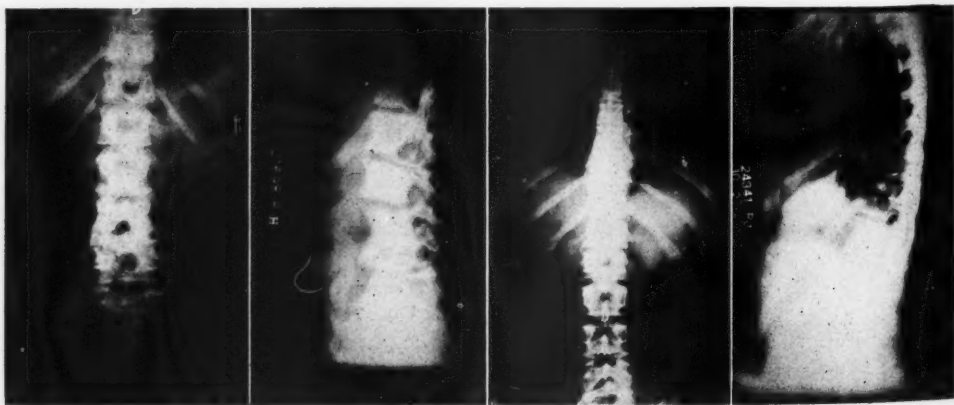
tures. The local results from these changes are pain and atrophy of soft tissue, together with hypertrophy and atrophy of joints.

This leads us inevitably to the matter of focal infection. In approaching this subject, it is well to definitely differentiate between *the focus of infection* and *focal infection*. The focus of infection should be understood, according to Billings, as circumscribed areas of tissue infected by micro-organisms. It may or may not be related to

focal infection. Focal infection further implies, according to Blum:

- (1) That there exists or has existed a circumscribed lesion or focus;
- (2) That the lesion is or was of bacterial nature and therefore capable of dissemination;
- (3) That from the focus there has resulted systemic infection or intoxication of contiguous or remote tissue.

Hence the causative organism of chronic



Figs. 22-A and 22-B. Streptococcal infection of spine.

Figs. 23-A and 23-B. Tuberculous spine.



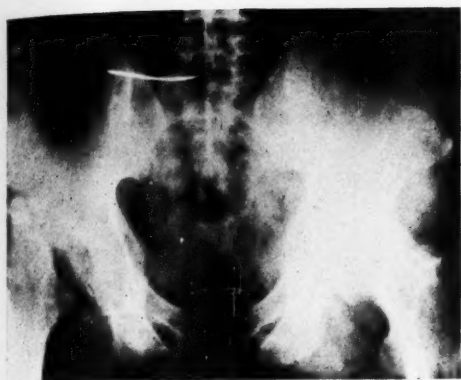


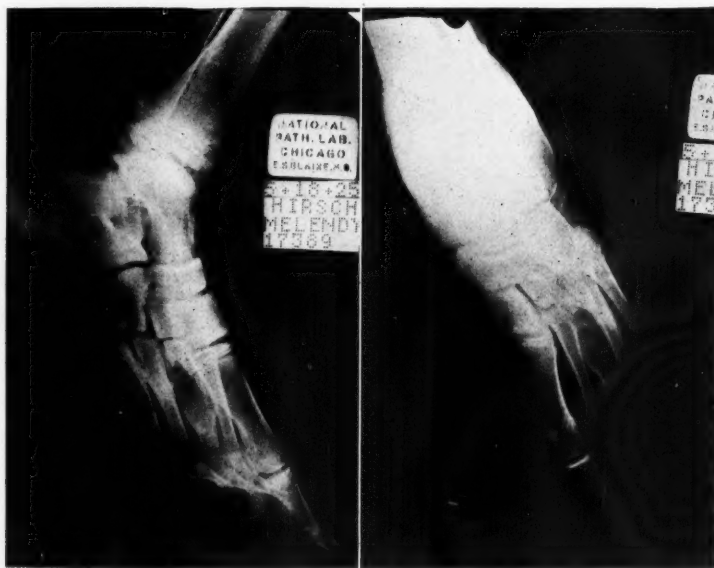
Fig. 24. Charcot hip.



Fig. 26. Tuberculosis of carpal bones and head of ulna.

infective arthritis is a focal infection, just as, in a broad way, syphilis or pulmonary tuberculosis is focal. In many cases the focus of infection may have been healed long ago, while the disease resulting will be the effect of a general dissemination of the causative germs or their toxins. Hence, we must conceive of the disease known as chronic infective arthritis as a disseminated general infection or intoxication and that it

has existed as such long before the pathological changes came about to dominate the clinical picture. In fact, the diseases known as hypertrophic, atrophic, and mixed arthritis no more represent primary clinical entities than do syphilitic aneurysms and tuberculous hips represent primary clinical entities. One might go further and state that the removal of the foci of infection in a well established case of infective arthritis



Figs. 25-A and 25-B. Bone cyst of the third metatarsal.

will have little more influence on the disease itself than would amputation of the penis in generalized syphilis or the excision of the

incidence of illness from rheumatism and heart conditions, cervical adenitis and ear conditions tends to be (1) lowest in chil-

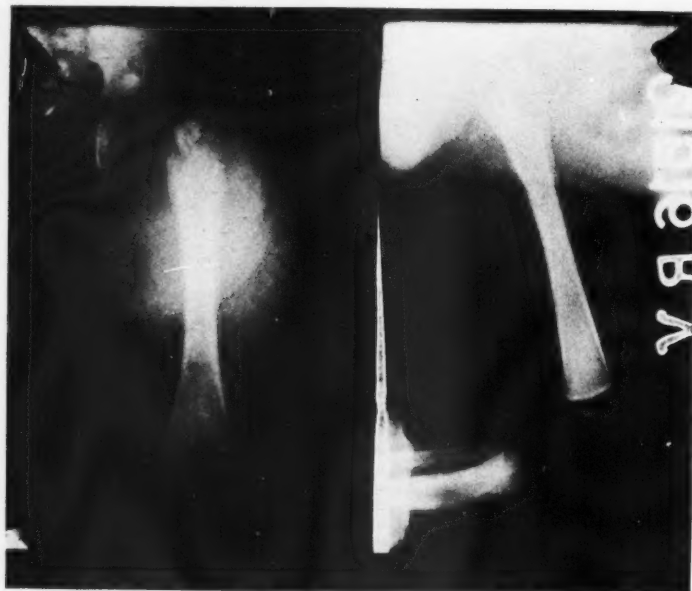


Fig. 27. Congenital syphilis.

upper lobe of the lung in generalized tuberculosis. This is not to be understood as meaning that the removal of infected tonsils will not be of benefit to the general wellbeing of a patient suffering as a result of infected tonsils or circumscribed areas of tissue infected with micro-organisms, but it does mean that the wholesale removal of tonsils, teeth, gall bladder, appendix, tubes, and uterus as curative measures in the treatment of chronic infective arthritis should be discouraged. We should not try to make our therapeutic measures more to be dreaded than the disease we endeavor to correct. Such measures are not indicative of right thinking on the part of the profession. Of course, when these ambulatory cases come in with their teeth removed, their tonsils out, and yet are no better—and the operation was done by a competitor—it shows that there has been very bad judgment. The

dren with normal tonsils; (2) higher in those with defective tonsils; (3) highest of all among those with removed tonsils. Presumably these more or less chronic conditions recover only slowly, if at all, after tonsils have been removed. In these, the dissemination has already taken place.<sup>2</sup>

As we have said, chronic streptococcus infection attacks bones and joints, but it also attacks tendons and their sheaths, ligaments, fascia, muscles, and nerve sheaths. It attacks the structures in many degrees of intensity. Involvement of these structures produces pain far more frequently than is generally suspected. Simply the fact that our X-ray film shows a lipping of joint surfaces does not justify the conclusion that the pain is in the joint: it may or it may not be. An X-ray film may reveal bone changes of long duration and those changes may be

<sup>2</sup>From the *Public Health Bulletin*, July, 1927, p. 175.

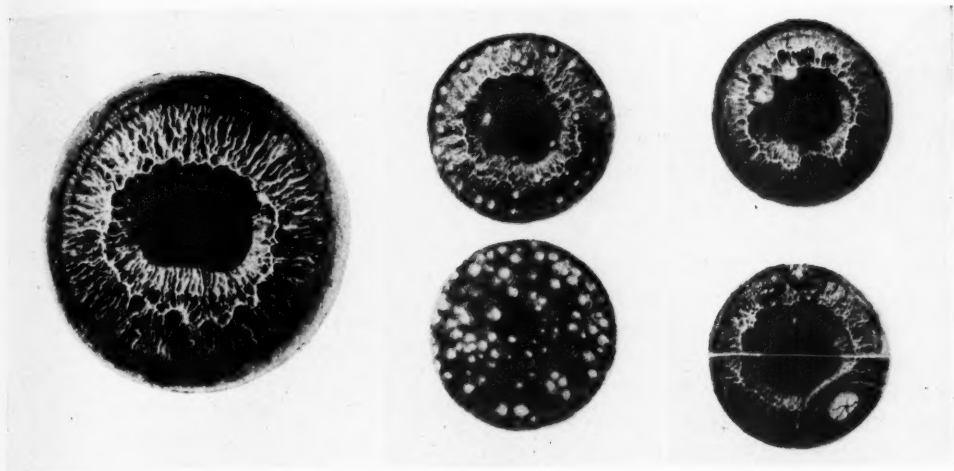


Fig. 28. Acute iritis.

Fig. 29. Tuberculous iritis.

Fig. 30. Syphilitic iritis.

symptomless. On the other hand, the pain may be relieved spontaneously and the bone changes progress. Too many abnormal joints are free from pain for us to reach positive conclusions. For example, the spine is frequently distorted to a very marked degree and that painlessly, while in the advent of some change, relatively obscure, the pain may be very intense and prolonged.

In our treatment of these conditions we have come to the conclusion that the disease known as arthritis is a chronic infective condition, in which the joint manifestations are the end-products of a long period of intoxi-

cation, which intoxication results from an infective process. We endeavor to combat this intoxication by the use of vaccine. We know that vaccine treatment is an empirical treatment, but if we administer any treatment with favorable results, controlling our zeal with intellectual honesty, we may have the sanction of scientific minds. By the nature of things, science is truth, yet with knowledge incomplete, we do not know all of the truth. So long as this condition exists, empiricism will live. Disease germs are relatively harmless in a healthy body, and, given an unhealthy body, we may get an approach

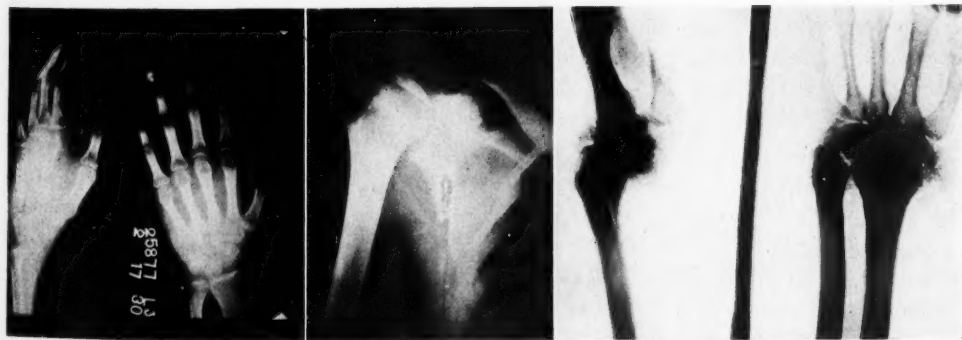


Fig. 31. Tuberculosis of head of metacarpal, middle finger.

Fig. 32. Brodie's abscess of head of humerus.

Fig. 33. Charcot wrist.

to the borderline cases, the obscure infections, by the use of the complement fixation or agglutination tests, using these tests as an index to health or disease. The value of vaccine treatment depends upon whether or not the bacterium used is pathogenic for the individual. If vaccines are made from strains fixed by the patient's serum, the results obtained are favorable.

In treating chronic infective arthritis, we are dealing with a non-self-limited disease, comparable only to syphilis and tuberculosis. In order to approach the problem of any of these conditions, it is necessary to envision the problem as a whole, and so, lacking any more definite picture in the line of therapeutics, the vaccine treatment appears to be the most logical. We cannot cure any of these diseases by attacking the affected anatomical systems, since the diseases are general. Of the three, streptococcic disease is most frequently encountered and its problem least often solved. We cannot but feel that if pulmonary tuberculosis were not a menace to public health, and if, in acknowledging syphilis, a man did not have to confess a sin, the problems presented by these two diseases would to-day be as unsolved as is that of arthritis. We may confine a tuberculous patient in a sanatorium lest he be a menace to public health; we can keep a patient with syphilis under our care for an indefinite period, because he does not care to tell his secret to any more physicians than necessary, but an arthritic will wander from one to another for an indefinite period, seeking always for an easy road to health. Specific vaccine treatment does not hospitalize him, is given by the hands of a physician, and can be carried on over a period of time with very favorable results.

In order to demonstrate the similarity and the multiplicity of lesions in various tissues of the body, we have prepared a series of illustrations to which your attention is directed. Up to and including Figure 21 they are arranged in the order of three,

the one to the left being always the streptococcic lesion, the one in the middle the tuberculous lesion, and the one to the right the syphilitic lesion.

#### DISCUSSION

DR. E. L. JENKINSON (Chicago): During our career as roentgenologists, our contact with disease lies to a great extent with the three great, non-self-limited conditions—syphilis, tuberculosis, and general arthritis. As a branch of the profession of medicine, we occupy a peculiar place, in that our opinion, if of a positive character, must of necessity carry with it a distressing conclusion. This is particularly true with arthritis. In tuberculosis and syphilis, the underlying condition is usually diagnosed prior to our employment. This is not true with arthritis, especially among those of us who are doing a large amount of industrial work. Unfortunately, it becomes our duty to sound that differential note between injury and disease. In giving that opinion, we are carrying a great responsibility. We cannot diagnose pain from a plate, and yet we are called upon to tell whether a given condition is disease or injury. If we call it injury, we may be imposing a long period of compensation, with hospital charges, upon the shoulders of an employing organization or an insurance company. If we call it disease, we are imposing a non-compensative diagnosis upon an injured employee. Hence, we are constantly in danger of being harassed by our own consciences, in the fear that by turning our opinion one way or the other, we may be doing someone an injury.

Lipping of joints does not necessarily cause pain. The tearing of a ligament may not cast a shadow on a film. With both present, it is our duty to decide which is the definite factor.

In listening to this paper we should all feel relief that finally arthritis is being approached from a causative, rather than a

therapeutic viewpoint. Our observation and our experience have taught us that, with the hospitalization of an injury with a concomitant arthritis the therapeutic measures are frequently worse than the disease; that the application of body casts, traction, demoralizing splints are frequently disciplinary measures and that the unfortunate patients, after submitting themselves for an inadequate period of time, choose to go on suffering from the disease rather than undergo the punishment which was designed and is necessary for their relief.

We should all hope for evidence of wiser judgment toward the problem of arthritis, and that the broad twilight zone of disease, characterized by fatigue and pain and various other subjective symptoms, may yield to definite diagnosis, and that the objective conditions, such as joint changes and resulting deformity, may be anticipated.

Arthritis has its quiescent stages, just as do syphilis and tuberculosis, but with this difference: Tuberculosis and syphilis are susceptible to diagnosis, while the remissive stages of arthritis may be heralded as a cure. If physicians are able to diagnose arthritis by serological methods, before the destructive processes have developed, a new phase will have been reached in the practice of medicine, and our work as roentgenologists will be relieved of a great deal of responsibility, in that we shall be asked to make our diagnoses from an objective viewpoint only, and our interpretations will not be made to yield themselves to subjective interpretation, with possible injustice to some one.

DR. C. S. WRIGHT (Toronto, Ont., Canada): With regard to the causative factors and treatment of arthritis, I would say that in our experience here, with Dr. Smith and myself at the Orthopedic Hospital, where we handle a good deal of arthritis, our ap-

proach has been directly along the lines Dr. Mayers has discussed. I would say this, in slight differentiation, that our experience is that removal of foci, if carefully examined and diagnosed, will contribute about 70 per cent of cures. Along with removal of foci we use vaccines, autogenous if possible. When we cannot get autogenous vaccine, we often try mixed vaccine. We are not always able to get sensitization work done, but even in those cases in which we use vaccine not directly from the foci of the patient, I think the thing we must watch is to use a dose small enough. We feel that about 70 per cent of the cases are curable and the other 30 per cent have foci that are not easily removable, as from the intestinal tract. The best approach I know of at the present time is by the older methods of elimination. Of the newer methods, perhaps the most exact is colonic irrigation, and after that modification of diet. We use special diets with the idea of modifying the bacterial flora and improving the vitamin and natural salts, and in that way eliminating foci. Perhaps I should not say with that idea only, but primarily with that idea, and it very often works. The diet must include a fair proportion of raw foods, fruits, and vegetables. The other element, of course, is going back to very old therapeutics again, to supplement those specific diets with foods that simply promote general health and upbuilding of that personal resistance which contributes to immunity. We not infrequently find quite elderly patients, sixty and sixty-five years of age—women, with all their joints involved, who respond and get perfectly well. I think these are not just exacerbations which have become quiescent, for we follow these patients over a period of years and they get well and stay well.

I have the greatest admiration for the way Dr. Mayers has expressed his views on this subject, and I think he is entirely right, and I believe we will reach definite results in ar-



thrititis by taking seriously the observations that he has made.

DR. JOHN HUNTER (Toronto): I think the first thing we should consider is heredity. We should find out all we can about the origin of our patient, the type of tissue with which he was born, his environment, his childhood, his youth and middle life, his vocation—all these things contribute to either susceptibility or to immunity. I think the great factor in the treatment of this disease is to establish immunity, that is, through physical means such as diet, physiotherapy, electrotherapy, and every way in which we can increase immunity to disease. I have listened to a great many papers and I have been impressed by the fact that seldom has any reference been made to the patient—it is nearly always to the focal trouble. Put your X-ray and radium here, there, and everywhere; but we seem to have forgotten the patient. I think the patient is the first consideration; his type and everything else is far above any local treatment. We may cure a diseased foot, but if the individual has some other trouble, we will learn of it in treating this rheumatic condition. I begin with the baby and watch him all the way along, as to diet, sunshine, and cleanliness. I watch his school days, his vocation, his shop, and everything I possibly can, to secure for him the best sanitary conditions in all his surroundings. In this way we may avoid arthritis in about 90 per cent of our cases.

DR. RALPH K. GHORMLEY (Rochester, Minn.): I was very glad to hear Dr. Mayers concur with me on tuberculosis and streptococcus infection. I think in our work it will help more and more if we study the singularity in the changes and types of changes in the joints themselves. So far as the actual cause is concerned, I do not believe we can lay it wholly to foci of infec-

tion; there are a good many things we do not know about it, particularly its chemistry. I believe the day will come when we will know more about the chemistry of the cells themselves of both the cartilage and the bone, and what these damaging factors do to those cells and from whence the products that cause the damage come. Focal infection has a good part to play, but I believe there are also metabolic changes, diets, etc., that produce the changes in the joint itself.

DR. MAYERS (closing): There are many things which contribute to the treatment of arthritis. I think I would be safe in saying that 30 per cent of cases recover spontaneously. The individuals who have had arthritis for twenty-five years will state that medical care has always been helpful and perhaps for a period of four or five years they have felt that the condition has disappeared, only to recur. In many cases, after the pain disappears, there is a time when most of the crippling and weakness take place, and that weakness is very profound and contributes to the permanent disablement.

Removal of foci of infection is frequently startling and spectacular in its results, yet four or five years later the arthritis may again appear and there will be no focus of infection found to be responsible.

In regard to metabolic changes, I do not see why the metabolism can be stated to have a definite relationship to this particular disease. We might ask, what are the metabolic changes of a patient who has had tuberculosis for ten years? After the first few years, having gone through the acute stage, if we follow the remission, we shall expect to find it altered.

The organisms which are responsible for arthritis attack just as many systems in the body as does tuberculosis, as I have shown here to-day. Certainly arthritis, as well as many chronic diseases, will alter metabol-

ism. We naturally employ any method available to improve the general condition of these persons—fresh air, sunshine, and heliotherapy will always be indicated.

So far as heredity is concerned, I have a feeling that this element plays a part in a great many diseases; in just what manner,

we are not prepared to say. We may be able to look forward to the eventual coming of a racial immunity, such as we are discerning in the history of tuberculosis and syphilis, yet I doubt this very much. The etiological factor is too widely distributed and present in too many mild conditions.

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## RADIOLOGICAL EVIDENCES OF UROLOGICAL DISEASES IN INFANCY AND CHILDHOOD<sup>1</sup>

By PERRY B. GOODWIN, M.D.,  
Radiologist to St. Francis Hospital, PEORIA, ILLINOIS

**I**N presenting this subject, it is our earnest desire to stimulate more interest in an undeveloped branch of medicine and surgery in infants and children, and to show its value to those concerned. Your attention is called to some of the outstanding—yet small—number of men in this country, who have made a study along these lines, namely, Hyman, Hinman, Stevens, Kretschmer, Beer, and a few others, including Patch, of Montreal.

The study of diseases of the urinary tract in infancy and childhood is receiving more and more consideration, and, as a result, great progress is being made in the recognition of these conditions in the young. Until the small caliber cystoscopes had been perfected, no real progress was made; a decade ago cystoscopy was considered rather a cruel procedure, hence no attempt was made to examine these young subjects in an efficient manner, as was done in the adult.

Very little to-day is said in text-books regarding the radiological study of urinary diseases or the diagnostic value of cystoscopy, radiography, or cystography. These possibilities were first pointed out by Nitze in 1907 and Beer in this country in 1911, and by Kretschmer and Helmholtz later. Such a co-operation between the urologist and roentgenologist is essential to the development and advancement of our methods of diagnosis.

For a long time it was considered that all we could do was to show a calculus, but by the development of the small cystoscope, opaque catheters and media, many pathological evidences have been shown on the film, and with the further development of

our Bucky diaphragm and cystoscopic tables with radiographic equipment, this method of diagnosis has become less complicated. We realize that this subject should be strictly a radiological one, but we are so closely associated with the urologists that their help must also be enlisted. In fact, no branch of medicine can be properly studied without due consideration to the clinical history, and especially in the case of the young, one must consider the laboratory and cystoscopic findings, which are as important to us as our X-ray evidence is to the urologists. We must not lose sight of the fact that this co-operation goes far in the evaluation of the clinical picture. We must keep in mind the various contours produced by pathologic conditions and how to interpret symptoms as well as shadows on the films. We have to consider the disturbances of micturition, dysuria, frequency, enuresis, hematuria, pyuria, pain and swelling in one or both kidney regions. For instance, dysuria, with frequency, may be caused by *Bacillus coli* infection, urinary tuberculosis, calculus, or foreign body.

When one reads that pyuria shows a mortality of from 10 to 18 per cent, it behooves all concerned to study these cases, both in adults and children. In cases of chronic pyuria, we must look for a cause of the supuration, as malformation, calculi, tuberculosis, tumor, abscess, hydro- and pyonephrosis. In order to obtain a definite picture of each case we must avail ourselves of cystoscopy, associated with catheterization of the ureters, and pyelography. Quite often the clinical signs are absent, and then we must employ roentgenographic methods to assist.

The kidneys of an infant are relatively larger than an adult's, but because they lack

<sup>1</sup>Read before the Radiological Society of North America at the Fifteenth Annual Meeting, at Toronto, Dec. 2-6, 1929.

the fatty capsule, and because a large amount of gas is present in the infant gastro-intestinal canal, the film of a young patient does not show the same definite outline of the kidney as does that of an adult. However, if we can show any evidence, for instance, of difference in the size of the kidneys, or any change in the contour of kidney outline, it may furnish the needful clew to the urologist. If there should be a shadow of a stone in a calyx, for example, it becomes important to the urologist to know the relative size of the stone, or whether or not it will probably pass down the ureter, or whether it is wasting time to prolong operation.

It is a fact that various lesions in childhood are the same as those encountered in the adult, though in the nature of things the carcinomatous type of malignancy and prostatic involvement are absent. Many of these young patients are treated with the hope that the condition will clear up, without subjecting them to the modern methods of diagnosis—cystoscopy and roentgenography.

It is imperative to use all the evidence obtainable if we hope to recognize the true pathology early and prevent a later mortality. Children stand the examination well; in fact, our cases have not shown as much reaction as have adults. In many cases a brief anesthesia is indicated, which need be of short duration only, if the urologist is rapid in his observations. The indications for cystoscopic and radiographic examinations are the same in these patients as in adults, and they should be done just as thoroughly.

The increasing tendency towards periodical health and life expectancy examinations in children no doubt will direct attention to their genito-urinary lesions. As we remarked previously, the importance of co-operation with the urologist becomes evident in cases in which we are called upon to differentiate between lesions of the abdomen and kidney. We are often surprised at the

number of cases which would have passed unobserved if it were not for the opaque catheter and media, and pyelograms especially, after the plain roentgenograms had proved negative.

The cystoscopic examination, with pyelograms, opaque catheters, and cystograms should be routine, unless contra-indicated by the presence of an acute infection or in cases in which the renal function has been markedly impaired.

Cystography is a valuable procedure, easily performed, for which no anesthetic is necessary, and gives valuable information in diseases of the lower urinary tract, often rendering cystoscopy unnecessary. It will reveal size, shape, and outline of the bladder, diverticula, ureteral refluxes, hydro-ureter, and hydronephrosis secondary to bladder obstructions.

Pyelography should be done cautiously, especially when the patient is under an anesthetic, because there is no guide to pelvic capacity.

There are several points of interest in radiologic and urologic study of pathology in infancy and childhood. First, it is difficult to elicit subjective symptoms, and second, it becomes more important to examine closely for objective signs. Pathology of the lower urinary tract presents such symptoms and signs as hematuria, tenesmus, dribbling, and enuresis. Anomalies of the genital system are often associated with anomalies of the urinary tract.

Urological diseases may be overshadowed by intestinal symptoms. Often the patient is treated for a pyelitis or cystitis, when surgery is indicated, urinary pathology being discovered only too late in the disease to prevent an early death, because advantage was not taken of modern diagnostic methods.

It is time we spread our radiographic teachings, so that the proper course may be taken with these young patients. It should be the rule that a complete urologic and

radiographic examination be made in the cases of infants and children, thereby preventing some of the mistakes. A cystogram, combined with a radiographic examination, is not difficult or dangerous, and gives more information than one might suspect; at least enough so that the patient can be given relief until time permits further examination. Such a study may call for the methods of cystoscopy, cystography, or ureteropyelography as necessary procedures—examinations which are just as safe, sane, and necessary in the child as in the adult.

Perhaps disease of the genito-urinary tract is not as frequent in infancy and childhood as in adult life; at the same time, if infantile cases presenting urinary symptoms and signs were given the same routine examination, we might demonstrate more pathology than is suspected.

Dr. Brown and Dr. Corbeille have made a study of eighty postmortem cases of the young taken at random: sixty-three would have started out with impaired renal function. This would indicate that urinary disease occurs more frequently than it is diagnosed. When there are persistent urinary symptoms, the routine examinations should be made, keeping in mind the upper urinary tract, because there may be a calculus that cannot be shown on the film. Cystography is very important in cases of pyuria, when it is difficult to clear the bladder. Some of the objective signs which require a routine study are: localized pain in the kidney or bladder, pus in a catheterized specimen of urine, abdominal tumor, enuresis, hematuria, and over-distended bladder.

#### CALCULI

These are more frequently found in the bladder than in any other part of the urinary tract, but may occur anywhere, from the kidney to the bladder. A roentgenogram should always be made of the whole urinary tract so as to detect any concretions higher

up. In our opinion, this should be done previous to any other examination—in so doing we will find calculi to be more common than is suspected. Some calculi consist of ammonium urate or uric acid, both of which substances have poor opacity and therefore may escape detection, but if located in the kidney or ureter an opaque catheter often meets with an obstruction. If this be followed by the injection of an opaque medium, we may then note a dilatation above or below the shadow, or irregular and nodular dilatation at the site of the shadow. Often in these radiolucent calculi, the opaque medium will show more density than the calculus and cause a mottled area due to displacement of the opaque medium. In the absence of opaque medium above it, one should suspect a calculus.

Bugbee reported thirteen cases of renal calculi in infants under one year of age, found at autopsy. Renal calculi in children are bilateral in from 6 to 10 per cent of cases.

If pyuria has persisted for a long time, one should not overlook a calculus in the bladder or lower ureter. Obstinate cases of enuresis should always be examined for calculi. Roentgenograms should be made, even though some calculi do not cast shadows.

#### TUMORS

The presence of a large mass which may almost fill the abdomen, even if hematuria is not present, should be examined with the opaque catheter and pyelograms. However, we may not be able to outline the tumor because of the dilution of the opaque medium with retained fluid, or obstruction due to the abnormal course of the catheter; we will often find the catheter displaced, causing one to suspect a tumor mass. In renal pelvic tumors, the outline of the pelvic wall will be altered. Under the classification of benign tumors, we have cysts—they may be



small, multiple, or large solitary. The large benign solitary cysts are of much more diagnostic and surgical importance. The malignant tumors in this region are hypernephromas.

The embryonal neoplasms which are found in infants are quite distinct from tumors in adults. They attain a large size rapidly, often completely filling the abdomen. Pyelography is of particular assistance in such cases, because there is a marked tendency of practically all renal neoplasms to invade the pelvis; as a result, the outline of the pelvis is irregular, with encroachment on parts of its circumference and a cup-like extension about the tumor mass. These appearances must be differentiated from the erosions, with enlargements of the calices typical of tuberculosis, and the very irregular pelvis of infection and elongated congenital polycystic kidney. Plain roentgenograms may show the kidney to be enlarged and the outline to be irregular. However, it is difficult to distinguish the different types of tumors, because there are no dependable signs. Generally the child will have, associated with a mass in the abdomen, weakness and malnutrition. In tumors of the bladder, roentgenograms are of little value if the growths be small, but when they are large and indurated, a shadow may be seen on a plain film; however, the cystogram, with opaque medium, is of the greatest value in showing the size and position of the tumor. Copious bleeding in a child under five years of age, with other clinical features characteristic of a tumor, and (generally) shadow on the film, is enough to diagnose renal sarcoma.

#### RENAL TUBERCULOSIS

This is not common except as a generalized body infection. Braasch reported only two such cases in children under ten years of age among 532 cases of renal tuberculosis. The changes which one will note on a pyelogram are strictures of the ureters,

necrosis of cortex, dilatation of the pelvis, deformity in the outline of the calices—such as a fuzzy or moth-eaten tip—loss of the cup-like appearance, which often appears as though the calices were separated from the pelvis. It is the belief that laboratory findings with a guinea pig inoculation are necessary.

#### HYDRONEPHROSIS

Many of these cases are congenital, due to pathology in other areas besides the kidney, such as strictures or kinks at the uretero-pelvic junction. Bugbee found fifty-three cases in a series of 4,000 autopsies, in which only one-third of the infants had lived more than six months. Hydronephrosis is often bilateral, due to obstruction in or below the bladder, and unilateral when obstruction appears in only one ureter. Of obstructive causes we mention incomplete strictures, slow growing tumors which press on the ureter, and calculi. Early changes may be seen on the pyelogram—the cupping disappears, the calices become globular, the pelvis becomes greatly dilated, often with an associated hydro-ureter, especially if the obstruction is in the bladder. The urologist should carefully and completely fill the dilated pelvis and ureters.

#### PYONEPHROSIS

This is a dilatation of the renal pelvis resulting from an inflammatory change in its walls. Here we find general irregularity, dilatation more noticeable in the calices, with a clubbing of the ends. When the inflammatory process extends farther, it causes destruction and necrosis. The necrotic areas may fuse with the calices, whereupon the pyelogram will show an irregular appearance of the kidney substance.

#### HYDRO-URETER

This is caused by obstruction of a variable degree—the longer the duration of the obstruction the greater the dilatation. The

lower the obstruction of the ureter, the greater will be the dilatation adjacent to it. The dilatation may extend upward until it dilates the calices, a condition more noticeable in bladder obstructions.

When the pelvic outline is irregular, one should suspect the presence of inflammation, such as is caused by tuberculosis. Calculi may not be shown, but often, when the ureter is injected, we find a dilatation above a certain point, in which case there is a chance that it is caused by a calculus, especially if the presence of tubercle bacilli cannot be demonstrated. A tumor in the lower abdomen may cause pressure in the ureter and produce a dilatation.

There are many causes of hydro-ureter into which the writer will not go at this time, mentioning only such conditions as chronic stricture and cicatricial constrictions due to infection or injury.

#### VESICAL DIVERTICULA

With a continuous obstruction, diverticula may be produced by internal pressure. These diverticula may reach an enormous size or be very small. They are generally to be found by the cystogram, especially if taken at different angles or stereoscopically after the bladder has been filled with an opaque solution. After draining the bladder of the solution, another cystogram should be taken, which will nearly always show retention of some of the solution in the pockets or diverticula. Such pouches are usually congenital in origin, but we believe they really have their beginnings in obstructions, though these may have occurred during fetal life.

#### ANOMALIES

Anomalies are not infrequently met with, and doubtless many unsuspected cases exist. On postmortem studies they are reported to be present in a percentage ranging from 1.5 to 2.5, but it is likely that when more

cases displaying urological signs and symptoms are studied, the percentage will be much higher. Many of these anomalies are found in the upper part of the urinary tract and lead to hydronephrosis and pyonephrosis. Before children are subjected to operative procedure we should be sure that there is a second kidney. Double kidney should be suspected if the pyelogram shows an abnormally placed single pelvis, in relation to the whole kidney outline. A pyelo-ureterogram should be made to demonstrate fused ureters, where only a single orifice is seen in the bladder.

#### POLYCYSTIC KIDNEY

Congenital polycystic kidney may be due to failure of union between the tubules, causing a cyst to form. The condition is generally bilateral. The cysts are mostly in the parenchyma, the kidney being enlarged in all directions, the effect most marked in the longitudinal diameter of the kidney, while the calices may be spread apart. On the pyelogram one notes that the calices are encroached upon, while contour and sharpness of outline remain; they may be short, broad, irregular, or obliterated. The pelvis is narrowed and elongated, but never dilated—this is an important sign.

In the forty-two cases of which Dr. Arthur Sprenger, urologist, and the writer have made a complete urological and radiographic study, they discovered 1 case of renal tumor (patient two years of age); 7 ureteral kinks; 1 bilateral polycystic kidney (patient two years of age); 1 congenital stricture (patient 13 months of age); 1 probable sarcoma; 5 strictures of the ureter (the ages of the patients ranged from five to seven years); 1 congenital infected hydronephrosis; 1 calculus in ureter (in patient six years old).

#### CONCLUSIONS

1. The main object of this brief paper is to increase interest in such urological

diseases during infancy and childhood as show radiographic evidence.

2. These young patients are amenable to the best methods of examination, and an earlier diagnosis has a share in lowering the mortality rate from urologic diseases later in life.

3. Cases of infants and children who present symptoms or signs pointing to the urinary tract should have a complete examination.

4. The most important evidence we have is that produced in roentgenograms.

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# EDITORIAL

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## DIAGNOSIS OF URETERAL KINKS AFTER INTRAVENOUS MEDICATION

Now that visualization of the urinary tract by intravenous medication is possible, there is sure to be an increasing demand for urograms. Therefore, the radiologist should beware of faulty reasoning from effect to cause. This error is never made in diagnosis with greater danger than in the case of the patient with unexplained abdominal symptoms, who is found to have a kinked or angulated ureter. The presence of acute angulation of the ureter in one who complains bitterly of pain that is referred apparently from the ureter presents such a likelihood of relationship between cause and effect that it is difficult for the clinician, and sometimes impossible for the surgeon, not to fall into this trap. When a patient returns several months after operation, the previous symptoms persisting, it becomes evident that kinks of the ureter occasionally occur in the presence of pathologic changes elsewhere.

The kidney and the ureter are held in position by entirely different supports. The ureter, which is attached to the posterior peritoneum, is fixed, whereas the kidney, under normal conditions, has considerable freedom of motion. Consequently, at the point where the ureter leaves the peritoneum

to cross posteriorly to the renal pelvis the ureter can become kinked when the kidney moves with respiration. It is evident, therefore, that if the roentgenographic exposure is made at the command to "take a deep breath and hold it," there will be a much larger incidence of ureteral kinks than if the exposure is made following expiration, when the kidney is in its cephalic position.

If the minor calices of the kidney are clear-cut, and if there is no evidence of dilatation of the renal pelvis, one must be cautious about attributing any symptoms to the kink in the ureter. Before a kink can produce pain, it must have resulted in urinary obstruction. Even a moderate amount, if intermittent, soon results in dilatation above the obstruction.

Seventeen years ago Childs and Spitzer wrote: "Angulations, curves, and kinks of the ureter are found in normal persons. As the shape of the ureter is due to its laxity or tenseness, either of which conditions may be normal, and its caliber varies considerably in normal subjects, and as it is still further altered by peristalsis, care should be exercised in drawing conclusions that pathologic conditions exist because of apparent abnormalities of shape and course or because of curves, kinks, and angulations or apparent constrictions."

Childs and Spitzer's observation has stood the test of seventeen years of increasing study and knowledge and is particularly applicable at this time, when it seems that the entire urinary tract can be visualized after intravenous medication.

HERMON C. BUMPUS, JR., M.D.  
GERSHOM J. THOMPSON, M.D.

## THE ANNUAL MEETING

*Los Angeles, California, Dec. 1-5, 1930*

On behalf of the Radiological Society of North America, the Los Angeles Local Committees extend to radiologists the world over a hearty invitation to be present at the Society's Sixteenth Annual Meeting.

Ordinarily in the early winter the climatic conditions in Los Angeles are very pleasant. The Hotel Ambassador, our headquarters, is delightfully situated and well adapted to the needs of a meeting such as ours.

Committees are busily engaged in working up an entertainment program which, while not distracting too much from the scientific character of the meeting, will, we hope, at least furnish pleasant relaxation and prove of sufficient interest to warrant your participation.

From present indications, it appears that the coming meeting will be a good one, well attended and representative of the Society.

Please consult the list of committees in the September issue of RADIOLOGY, and write to the Chairman of any of them if detailed information is desired.

ALBERT SOILAND, M.D.

*Chairman, Local Executive Committee.*

## ANALES DE RADIOLOGIA

True to Cuban medical traditions, the comparatively small group of Cuban radiologists are the proud publishers of the only radiological review in the Spanish language, *Anales de Radiologia*, official organ of the Sociedad Cubana de Radiologia y Fisioterapia. It is handsomely printed, classically written, and generously illustrated. In many an article, the author backs up his academic dissertation by the practical procedure of case presentation, thus giving his essay the seal of originality. The writer feels that *Anales de Radiologia* is a publication capable of honoring any radio-

logical organization, of any size, in any language.

RADIOLOGY, through the undersigned, wishes to acknowledge, with thanks, the salutation of the Executive Committee of the Sociedad Cubana de Radiologia y Fisioterapia, appearing in the first number of *Anales de Radiologia*, and hopes for their splendid publication a long and prosperous life.

P. R. CASELLAS, M.D.

## BOOK REVIEWS

STORY OF ELECTRICITY AND A CHRONOLOGY OF ELECTRICITY AND ELECTROTHERAPEUTICS. By HERMAN GOODMAN, B.S., M.D. With an Introduction by VICTOR ROBINSON, M.D. Pages 62; full-page portraits, 12. Published by Medical Lay Press, New York, 1928.

Dr. Goodman has written a short history of electricity, with special emphasis on the cycles of development, particularly as regards electrotherapeutics. The short biographical sketches of many of the pioneers in this vast field lend much to the interest and value of the book, while the portraits help to visualize what these pathfinders looked like.

This book is written in readable style and your reviewer has found it so interesting and full of important historical data that, instead of giving it a casual examination, for the purpose of review he has read it through twice.

The "Chronology of Electricity and Electrotherapeutics" from 600 B. C. to A. D. 1927, covering five pages, is interesting and valuable. The only error your hypercritical reviewer has found is that 1893 is given as the year Röntgen announced the discovery



of the X-rays; but this is given correctly (as 1895) in the biography of Röntgen.

It is a valuable collection of practically all the known data, condensed into small and convenient form, and should be in the library of every radiologist.

I. S. TROSTLER, M.D.

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THE EFFECT OF ROENTGEN IRRADIATION ON THE INTERRELATION BETWEEN MALIGNANT TUMORS AND THEIR HOSTS. By CARL KREBS, M.D. Supplement VIII to *Acta Radiologica*. Stockholm, Sweden, 1929; 133 pages and 3 plates. Price, \$6.90.

This excellent monograph is a summary of the author's investigations of the effects of lethal and lower doses of X-rays on a mouse carcinoma and sarcoma. He shows that for these tumors only doses of more than 6 H.E.D. are lethal, both *in situ* and *in vitro*; that doses lower than this produce only inhibition of the tumors, and that preliminary irradiation increases the power of the organism to resist tumor subsequently implanted subcutaneously in the exposed region.

This work gives a clue to the answer to many of the puzzles in roentgenotherapy, and merits thorough study by both the radiotherapists and biologists.

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## ARTHRITIS

**Sciatica.** A. P. MacKinnon. *Can. Med. Assn. Jour.*, April, 1930, XXII, 492.

The object of this paper is to show that all the features of idiopathic sciatica can be accounted for by an infectious lumbosacral arthritis. Hence, in cases where such arthritis can be proved to exist, the sciatica should not be classed as "idiopathic," but as "symptomatic" of arthritis.

The paper is based on and is an appreciation of the work of Danford and Wilson, who published in the January, 1925, issue of the *Journal of Bone and Joint Surgery*, the results of an extensive anatomical study of the bony relations of the sciatic nerve. They showed that on anatomical grounds the neurological findings of a typical case of idiopathic sciatica can be accounted for by a neuritis of the fifth lumbar root. They also found that the anatomical relations of this fifth lumbar root are such that osteo-arthritic changes, in the region of the lumbosacral articulation, would compress it and produce sciatica.

In the X-ray examination of every patient complaining of sciatica good films are important. They should consist of stereoscopic films made with the vertical shift, and a lateral. Gross lesions, such as lumbosacral tuberculosis, newgrowths, spondylolisthesis, and osteo-arthritis of the hip must be ruled out. The X-ray examination should concentrate first on lipping of the bodies of the vertebrae. Such a finding would suggest associated changes in the adjacent articulations. These latter should then be studied closely. Lumbosacral anomalies should be investigated. Finally, negative X-ray results do not rule out the ordinary infectious arthritis which shows no bony changes in the early stages.

L. J. CARTER, M.D.

## BONE (DIAGNOSIS)

**Epicondylitis Humeri.** K. G. Hansson and I. D. Horwich. *Jour. Am. Med. Assn.*, May 17, 1930, XCIV, 1557.

Better known as "tennis elbow," this has been a subject for investigation since 1896.

Described as a well defined clinical entity, with marked pain and tenderness above the elbow, it occurs after a great muscular exertion or some continuous labor. The symptoms follow such games as tennis, polo, baseball, and squash, or such occupations as pressing clothes with heavy irons, typewriting, bricklaying, carpentry, or painting. It apparently offers little evidence from the roentgenographic standpoint. The antero-posterior and lateral roentgenograms are negative; some observers have reported roentgenographic evidence of a periostitis.

The authors' concept of the pathologic condition is that of a periosteal fracture with a myofascitis of the extensor muscles which originate from the external epicondyle.

No treatment is of any avail unless the extensor muscles from the external condyle are relaxed.

C. G. SUTHERLAND, M.D.

**Destruction of the Os Pubis by a Lymphangioma.** E. Saupe. *Röntgenpraxis*, May, 1930, II, 469.

A case is described in which a roentgen examination showed an area of destruction in the right pubic bone. The patient, an adult male, had a spindle-cell sarcoma of the thyroid. The bone destruction, however, was not caused by metastasis but by a lymphangioma, which was found at autopsy.

H. W. HEFKE, M.D.

**A Case of Sclerosing Osteitis Involving One Limb.** Eugenio Milani. *Archivio di Radiologia*, January-February, 1930, VI, 70.

The author reports a case of sclerosing osteitis which he has followed for more than a year. The thickening was along the internal margin of the right femur, and was accompanied successively by small areas of thickening of the tibia and the astragalus.

This lesion was first described by Leri and Joanny in 1922. Other cases have been reported by Lewin and MacLeod (1925), by Putti and Muzii, Perussia and Meda (1927), and by Zimmer and Valentin (1928). It is interesting because of its possible relationship

to that form of chronic osteomyelitis first described by Sicard and Ragueneau in which the increased density is limited. Its radiologic appearance is characterized by the involvement of the whole or part of the length of the member by the hyperostosis and by the fact that the lesion may cross the joint onto adjacent bones. All cases occurred in the young. The lesion is frequently confused with osteomyelitis.

E. T. LEDDY, M.D.

**Unilateral Duplication of the Patella: A Congenital Anomaly.** Max Climan. *Med. Jour. and Rec.*, June 4, 1930, CXXXI, 558.

This anomaly, when it occurs, is usually on both sides and can thus be diagnosed from fracture with certainty. It is occasionally unilateral and has been mistaken for fracture. The differentiation depends on the observation that in congenital anomaly the fragment is smooth, with cortical bone, while in fracture it is serrated and is cancellous bone. The separate fragment in the case of anomaly is in the upper and outer quadrant in all reported cases, while this is rarely the seat of fracture.

W. W. WATKINS, M.D.

**CANCER (DIAGNOSIS)**

**The Age Incidence of Carcinoma.** Theo. R. Waugh and T. L. Fisher. *Can. Med. Assn. Jour.*, May, 1930, XXII, 619.

The material from which these statistics were gathered comes from the broad hospital service of the Royal Victoria Hospital, Montreal, and includes outdoor minor surgery, general surgery, urology, gynecology, otolaryngology, etc. The figures are obtained from the records of the Department of Surgical Pathology, and cover a period of fourteen years, from 1915 to 1928. Only carcinomata positively diagnosed by microscopic section are included. The only cases reported are primary malignant epithelial tumors.

During the period from 1915 to 1928 a total of 22,993 surgical specimens were examined, of which 1,756, or 7.63 per cent, were primary cancerous growths; 63.6 per cent were from females, and 36.4 per cent from males. The

average age of all the cases was 53.5 years; that of the females 50.6 years, and that of the males 56.5 years. The age incidence showed a gradual increase from age 25 to age 50, was constant from 50 to 65, and then gradually decreased. This decrease after 65 does not represent less liability to cancer after that age, but simply represents the fewer persons who reach that age. The regional incidence shows breast cancer largely predominating.

Generally it was found that carcinoma arising from glandular epithelium tends to occur earlier in life than that arising from squamous epithelium. To this rule there are two main exceptions, namely, the cervix and the prostate, both of which derive their epithelium from the mesoderm. The squamous cell carcinoma of the cervix occurs chiefly in the early period of life, while the carcinoma of the glandular prostate occurs chiefly in old age.

L. J. CARTER, M.D.

**Statistical and Systematic Studies on the Malignant Tumors Observed during 1928.** Ferruccio Vigi, Giovanni Dagnini, and Giuseppe Mareggiani. *Rivista di Radiologia e Fisica Medica*, March, 1930, II, 221.

This excellent study concerns 775 autopsies performed on 1,666 patients dying in the hospitals of Bologna, in which series there were 104 malignant tumors. This article should be consulted in the original by those interested in clinical cancer research.

E. T. LEDDY, M.D.

**Primary Carcinoma of the Lungs.** Pedro L. Fariñas. *Anales de Radiologia*, January, 1929, I, 47.

The paper is based on twenty-six cases of primary carcinoma of the lungs in which the diagnosis was established either by biopsy, necropsy, or clinical course. Many radiographs and photographs of the specimens are shown. The author classifies these tumors as infiltrating or nodular encapsulated—the former arising either from the hilum or from the parenchyma, the latter being always of parenchymatous origin. The differential diagnosis



between these tumors and non-malignant conditions of the lungs is discussed.

The author emphasizes the fact that carcinoma may follow chronic diseases of the lungs, accompanied by metaplasia of the bronchial epithelium, and makes the suggestion that these cases should be observed by serial radiography, with the hope of making an early diagnosis.

M. VIAMONTE, M.D.

### CANCER (THERAPY)

**Treatment of Mammary Carcinoma by Radiation.** Sir G. Lenthal Cheate. *Brit. Med. Jour.*, May 3, 1930, No. 3617, p. 807.

The two objects of the article are, first, to describe how pathological observation shows that the whole of the breast itself should be radiated in carcinoma of that gland, and, secondly, to describe the method the author adopted in delivering interstitial radiation to a breast containing carcinoma. He then opens the paragraph on biological effects of radiation by stating that the treatment of carcinoma by this method is in an exceedingly tentative and experimental state, and believes that at present we are judging our results from the effects of doses that may be a great deal too large and administered for too long a period at a time. For if little or no result is seen from a given dose, larger doses are employed, when, for all that is at present known, smaller doses frequently delivered in short periods at frequently repeated intervals may be more successful. Moppett is quoted as having isolated wave lengths that retard growth and those that stimulate growth, and believes that a proper manipulation of the wave lengths that retard growth may replace all other forms of radiation therapy.

The author then discusses what is meant by (1) external and interstitial radiation, and (2) the radiosensitivity or radioresistance of tumors. While it is certain that the regression of a tumor after radiation depends on the effect on the tumor cells, there is also a considerable amount of evidence that another factor involved is to be found in the reaction of the tissues in which the tumor lies. This is

thoroughly discussed and experimental evidence from the literature is given. The author takes nearly a page to give his reasons for radiating the whole breast in carcinoma, as well as the axillary and cervical regions, and from the stress that he places on this, one would judge that this is not being done by radiologists of the author's acquaintance, a technic quite different from that of American radiologists by whom the necessity of radiating the whole breast is more or less taken for granted.

A paragraph on clinically undetectable tumors is of considerable interest, and examples of such cases are given. In one of these the tumor of the breast could not be detected by clinical examination, and was discovered only during complete microscopical examination of whole sections. This was done because a tumor removed from the right axilla had been shown microscopically to be carcinoma in a lymphatic gland.

Cheate then discusses radiation *versus* radical operation, and again emphasizes the necessity of including the axillary, supraclavicular, and intercostal regions, and the subcutaneous tissues of the chest in every case, no matter how localized to the breast the disease appears to be. His statement that radical removal of an operable carcinoma of the breast will always be safer than an inadequate radiation of the gland is only too true. He discusses his technic for interstitial radiation, and states that, as the result of five cases, he has been able so far to support the convictions of G. L. Keynes, who believes that interstitial radiation is the operation of choice in the treatment of early carcinoma of the breast. The author uses the same principles and technic as Keynes, that is, small units of radium with heavy filtration.

H. J. ULLMANN, M.D.

**X-ray and Radium Treatment in Cancer of the Cervix.** W. M. Sheridan. *Southern Med. and Surg.*, June, 1930, XCII, 411.

In determining whether or not a woman has cancer of the cervix, bimanual examination, visual inspection of the cervix, and biopsy should all be employed. Cancer confined to

the cervix may be eradicated by X-rays and radium or by the Wertheim operation. Panhysterectomy should not be performed, and when the disease has spread beyond the cervix the Wertheim operation is of no value.

The technic advised is to give deep X-ray therapy over the lower abdomen and back, each side, and perineum, at 200 K.V., 0.5 mm. copper filter, 50 cm. distance, 5 ma., over each area except the perineum, which receives half of this dose. After two weeks' time any cauliflower mass which has not disappeared is destroyed by electrosurgery. Radium is then applied by embedding in the cervix and by application within the cervical and uterine cavities. Four 10 mgm. needles are embedded and left for 24 hours, and 50 mgm. tubes are placed in the cervical canal and uterine cavity for 24 hours, the filtration being 1 mm. of brass and 1 mm. of rubber or aluminum.

W. W. WATKINS, M.D.

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**Cancer Therapy with Fractional (Scattered) X-ray Treatments. G. Miescher. *Strahlentherapie*, 1930, XXXVI, 434.**

The time factor deserves more consideration in radiation therapy than it has been given so far. The work of Regaud and Coutard has shown this very convincingly. Better results in roentgen therapy of malignant tumors may be obtained if the technic used in radium therapy is imitated, i.e., if small doses are given over a long period of time. Coutard, for instance, treats his cases one to two hours daily at 40 to 50 cm. F.S.D. through 1.5 to 2.0 mm. Zn over areas of 100 to 250 sq. cm., with very small intensities. The duration of treatment extends from 15 to 20 hours, distributed over 14 to 40 days, and the total dose amounts to from 12,500 to 37,000 French r-units. The skin reactions were relatively mild.

Miescher conducted a series of animal experiments along these lines and then tried the method in treating human carcinoma. If the effect of roentgen rays applied to the ear of a rabbit in fractional doses (400 r each) was compared with that of one single high dose, an increase in the tolerance was already notice-

able, with a three-hour interval between exposures. When allowing a 24-hour interval to elapse between the fractional doses the tolerance increased two and one-half to three times. Longer intervals did not influence the toleration further. On 26 patients it was shown that daily doses of from 200 to 240 r may be applied up to a total of 4,000 r, without producing serious injuries during a period of two years' observation. The acute reaction appears usually on the sixteenth day and is over on the forty-eighth day; erosions are often observed. In one patient who had an involvement of the left cervical muscles, the reaction following the application of 3,740 r given in 17 daily doses of 220 r each through 2.0 mm. Zn over a  $17.5 \times 14$  sq. cm. field, could be studied histologically for 91 days. Twelve biopsies were performed on the 5th, 10th, 15th, 20th, 27th, 31st, 37th, 44th, 50th, 57th, 70th, and 91st days.

It appeared that the reaction corresponded to that of an intense treatment applied in one sitting; however, the changes in the connective tissue were considerably less. This is, in the author's opinion, the most important advantage of the fractional method. In many advanced cases of carcinoma the response of the tumors was remarkable, and further study and perfection of the method are indicated. For skin carcinoma of small size the application of a single massive dose still remains the method of choice.

E. A. POHLE, M.D., PH.D.

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**On Radiation Therapy in Cancer. A. T. Todd. *The Lancet*, April 26, 1930, CCXVIII, No. 5565, p. 906.**

The author reviews briefly the theories of specific action on cancer cells, radiosensitivity, etc., and believes that some of his experiments appear to furnish evidence against the specific action of radiation on cancer. He believes that the regional response to radiation therapy is the important reaction. The hypothesis is that the local defense mechanism against cancer is probably the junction tissue, that is, the mesoblastic defense barrier, which tries, apparently in vain, to limit the spread of the

growth. This tissue is not well known and its possible significance has not been appreciated. It consists of lymphocytes, plasma cells, monocytes, and macrophages, various phases of fibroblasts, eosinophile and basophile leukocytes, and the blood and lymph channels. The slowly growing cancer has much of this junction tissue while quickly growing cancer has little. This junction tissue is frequently termed the stroma.

Todd offers an example to show that radiosensitiveness of a tumor is directly proportional to the amount of this junction tissue. The general defense against cancer is also of importance, and evidence for this is obtainable from the behavior of implanted cancer in animals, and from clinical observation of cancer patients treated by medical methods. He then states that successful treatment of cancer in man is accompanied by definite changes in the blood—increase of small lymphocytes and eosinophile leukocytes—and a diminution of that lipase which can split tributyrin. There is also evidence for the participation of the reticulo-endothelial system in the general defense mechanism. When the activity of the system is diminished or paralyzed by blockade, that is, when every cell has completely filled itself with the particles of an electro-negative colloid extracted from the blood stream, the implantation of cancer is facilitated.

A page and a half is devoted to arguments and experimental evidence that the stroma and general defense mechanisms are the important factors in the favorable reaction of malignant tumors to radiation. The author admits that there is plenty of evidence that radiation affects the cancer cell itself adversely, probably by inhibitory action on mitotic division, and thus prevents the continuity of growth. He considers that this immediate action is of less importance than, or even perhaps produced by, the mediate action of radiation which takes place locally in the junction tissue, a stimulation of its defense, and generally in those parts of the mesoblastic tissues which are concerned with defense mechanisms, especially certain cells of the blood and the reticulo-endothelial system. He believes that acceptance of these views will be followed by further modification of radiation technic in the direc-

tion of smaller doses applied for longer times, or at repeated intervals, and also with greater screenage. A fresh viewpoint may help to prevent the disappointment for which the current conception of radiation and the resultant technic are responsible.

H. J. ULLMANN, M.D.

#### **Radium Therapy of Carcinoma of the Vagina. Iwan v. Büben. *Strahlentherapie*, 1930, XXXVI, 503.**

It is often difficult, if not impossible, to differentiate primary and secondary carcinoma of the vagina. Only cases in which the neoplasm is confined to the vagina itself and does not involve the neighboring organs can be classified under that heading. The author observed 29 patients suffering from primary carcinoma of the vagina, 28 of whom were treated by X-rays and radium during 1919 to 1929. The radium dose of 1,200 to 2,400 mg.-hrs. was usually applied in one sitting and, if necessary, repeated after from 6 to 8 weeks. Nine patients were alive at the time of writing this report. Four patients lived 9, 6, 4, and 2 years, respectively, following the treatment; 5 patients had been treated less than 2 years previous to the report. Six women lived from 1 to 3 years following irradiation; 12 patients died within one year, and 1 case could not be traced.

E. A. POHLE, M.D., PH.D.

#### **THE CHEST (DIAGNOSIS)**

**A Clinical and Roentgenologic Consideration of Pulmonary Infarction. B. R. Kirklin and Louis S. Faust. *Am. Jour. Roentgenol. and Rad. Ther.*, March, 1930, XXIII, 265.**

All the signs and symptoms of lodgment of a pulmonary embolus can occur without the development of any physical or roentgenological signs, for unless some degree of passive congestion is present infarction is not apt to take place.

The usual clinical findings are sudden onset of dyspnea and pain in the chest, with a moderate elevation of temperature, pulse, and leu-

kocyte count, and usually with hemoptysis. Roentgenologically, the infarct presents a large triangular shadow, with its base toward the axillary line, and usually with associated clouding of the costophrenic angle. There may be so much surrounding inflammation as to make the infarct indistinguishable from a pneumonic process. Occasionally the infarct shadow is round, which indicates that the base is lying anteriorly or posteriorly.

In 25 cases studied roentgenologically at the Mayo Clinic, there were definite X-ray changes in all cases with definite physical signs, and in several with indefinite physical findings. In 18 of the cases the infarct was at the base of the right lung, while in 4 cases infarcts could be demonstrated in both lungs. Clouding of the costophrenic angle was almost invariably present. Thickened pleura was the commonest complication. At times the pneumonic changes were so marked as to make the condition indistinguishable from bronchopneumonia.

In certain cases old unresolved infarcts may be demonstrated by the roentgenogram when physical signs are no longer present.

J. E. HABBE, M.D.

**Roentgenologic Diagnosis of Diseases of the Upper Respiratory Tract in Children.** Henry K. Pancoast and Eugene P. Pendergrass. *Am. Jour. Roentgenol. and Rad. Ther.*, March, 1930, XXIII, 241.

The authors believe that all children referred for chest X-ray study should have a simultaneous examination of the oropharynx and neck by erect and prone lateral film examination, made both at the end of crying inspiration and at the end of expiration, with the head so held midway between extension and flexion so that the neck is straight with the body. A modification of the chair used for encephalography is used for taking the film in the erect position. On the lateral views the arms are held down and back of the chest. With the exception of the detection and localization of foreign bodies, nearly all the information of pathological neck conditions is to be obtained from the lateral view.

All of the following structures in adult life

and many in infancy and childhood can be visualized on the lateral neck films: pharynx, posterior border of tongue, uvula, epiglottis, arytenoid cartilages, aryepiglottic folds, superimposed pyriform sinuses, the vestibule of the larynx, the ventricular folds, ventricles of larynx, cricoid cartilage, lower extremity of the larynx, and the trachea.

In five cases of post-diphtheritic stenosis of the larynx, all showed narrowing of the subglottic region of the trachea.

In tuberculous conditions the most significant X-ray finding is calcified cervical glands.

Retropharyngeal and retrotracheal abscesses are quite easy to diagnose by properly taken neck films, and show a decided increase in thickness of the soft tissues anterior to the vertebral bodies.

With regard to the thymus question, the authors follow the belief of Chevalier Jackson, that in many instances the thymic menace is one of mechanical tracheal compression, and, therefore, they advocate the lateral film as being of most value in showing tracheal narrowing at the thymus level, particularly since Jackson states that thymic tracheo-stenosis is worse in the erect posture. The thymus usually does not obstruct because it is wide, but because it is thick. In pathologic enlargement of the thymus one may show the following on the lateral view: narrowing of the thoracic inlet air space on inspiration, too great collapse on expiration, buckling of trachea at either phase, and (on sagittal view) lateral deviation of trachea.

J. E. HABBE, M.D.

**About the Relationship between Bronchiectasis and Tuberculosis.** Georg Simon. *Med. Klin.*, June 6, 1930, XXVI, 852.

During his work in a tuberculosis sanatorium the author has paid particular attention to the occurrence of bronchiectasis in combination with tuberculosis. He has seven times seen small bronchiectasis, only demonstrable by Iodipin contrast filling, together with healed "primary complexes." Four times he could follow up the development of bronchiectasis in active tuberculosis. A chronic tuberculosis may lead to bronchiectasis rather



frequently, probably through mixed infection of the bronchial tubes and the pull of the scar tissue. The question of how often tuberculosis in infancy and childhood may lead to bronchiectasis must still be left open.

H. W. HEFKE, M.D.

**Broncholiths, with Report of Four Cases.**

John J. Lloyd. *Am. Jour. Med. Sci.*, May, 1930, CLXXIX, 694.

Broncholiths are probably not as uncommon as the number of reported cases would lead one to believe. They arise from a deposit of calcium salts in bronchiectatic cavities, from sequestra of a bronchial cartilage, and many arise in the lung tissue outside the bronchi proper. Chemically, they have the same composition as bone. However, microscopically, they do not have the same cell structure. Many authors consider them to be obsolete tubercles.

Chevalier Jackson divides lung stones into three classes: "(1) True calculi; (2) calcium deposits in tissues that sloughed loose and gained entrance into the bronchus; (3) pneumoconiotic, silicotic, or anthracotic material that has loosened by disintegration or suppurative liquefaction of the encasing tissues."

Samuel West gives the incidence as sixteen in a thousand cases of tuberculosis, but thinks that this is a high percentage.

The author collected eighteen cases from English literature since 1900, and adds four more cases of his own, with roentgenograms. These cases are very interesting and well illustrated. He feels that the erosion of a calculus into a bronchus may occasionally account for a post-hemorrhagic spread of tuberculosis as well as produce bronchiectasis, lung abscess, or empyema.

ROE J. MAIER, M.D.

**X-ray Diagnosis of the Complications of Influenza.** C. D. Enfield. *Kentucky Med. Jour.*, May, 1930, XXVIII, 222.

The complications of influenza in which X-ray aid is most frequently invoked are those about the head and in the chest. Any sus-

pected complication of influenza in the chest should be examined by X-ray, as this will frequently give information not obtainable in any other manner. Whether the lesion is empyema, free or encapsulated, or pneumonia—developing or fully developed—the X-ray will help materially in ascertaining the true conditions. The examination of the nasal accessory sinuses and of the mastoid areas by the X-ray should be routinely carried out, if there is any suggestion of infection in these.

W. W. WATKINS, M.D.

**Contribution to the Radiologic Study of Pleuritis in Acute Pulmonary Diseases: The Reaction of the Contralateral Pleura.** G. Giuseppe Palmieri and Giuseppina Urbani. *Rivista di Radiologia e Fisica Medica*, March, 1930, II, 149.

In all cases of acute affections of the lungs a reaction of the pleura can be demonstrated radiographically, even though it may be a very slight one. This reaction is characterized by a thin marginal opaque strip which may extend on the right side as far as the interlobar fissure. This strip is demonstrable not only on the affected side but is also frequently present in the opposite lung at the same metamerical level, according to Palmieri. The clinical and radiologic findings are most likely a contralateral pleuritic inflammatory reaction.

E. T. LEDDY, M.D.

**Tracheobronchial Adenopathy in Children.** G. H. Withers. *Southern Med. Jour.*, June, 1930, XXIII, 547.

In arriving at the true status of the bronchial nodes from the roentgenogram, there are certain hazards and limitations. The technic of McPhedran minimizes this, and in making and interpreting the roentgenograms the following facts must be kept in mind: The density of the nodes is similar to the structures surrounding them, and an uncalcified node will cast no shadow unless it is larger than the structure upon which it rests; enlargement of mediastinal nodes from acute infection will not record. Exposures must be synchronized with late diastole to avoid dis-



tortion from cardiac motion. Films in various positions are frequently required.

W. W. WATKINS, M.D.

**The Roentgenological Appearance of Echinococcus of the Lung and its Differential Diagnosis.** Hans Fetzer. *Röntgenpraxis*, May, 1930, II, 417.

One can distinguish a closed and an open type of echinococcus of the lung, open when the cyst is in connection with a bronchus. The closed type may easily be mistaken for a solid tumor, either primary or metastatic. The open type may be difficult to differentiate from an abscess or cavity of other etiology. Other clinical and serological examinations must confirm the diagnosis, but the radiologist should at least mention the possibility of this disease.

H. W. HEFKE, M.D.

#### THE CHEST (THERAPY)

**Tracheobronchial Adenitis.** Charles P. Emerson. *New York St. Jour. Med.*, June 1, 1930, XXX, 651.

Along the lower trachea, at the bifurcation of the primary bronchi, and along the larger bronchi, are groups of lymph nodes which may play a large part in the pathology of chronic pulmonary disease. These nodes mark the starting point of many of the cases of so-called central pneumonia, or bronchopneumonia, so common during and after the influenza epidemic.

In the treatment of tracheobronchial adenitis the author has used moderate X-ray therapy with great success.

W. W. WATKINS, M.D.

**Roentgenotherapy of Bronchial Asthma.** Gastone Torelli. *La Radiologia Medica*, January, 1930, XVII, 16.

The author reviews the modern literature on bronchial asthma and refers to four cases treated by X-rays. This method is considered as indicated (a) when the cause is not known, and it is, therefore, impossible to adopt any specific therapy; (b) whenever the agent appears resistant to radiation, i.e., tumefied

ganglia, endocrine alteration, etc. It is not recommended in the presence of emphysema. The effect of X-rays may be explained (1) as a reducing action upon the tracheobronchial ganglia; (2) as a regulating action on the endocrine system; (3) as a complex stimulation on the neuro-vegetative system. The author advises radiation of the lungs and spleen—dosage 20 to 30 per cent. E.S.D., 100 to 150 sq. cm. in three or four days.

L. MARINELLI.

#### CONTRAST MEDIA

**Normal and Pathologic Skialography.** Filippo Rocchi. *Rivista di Radiologia e Fisica Medica*, January, 1930, II, 1.

The author discusses his method of X-ray examination of the salivary glands by the injection of iodized oil into Stenson's duct by means of a special syringe of simple construction. He describes and illustrates the normal image of the parotid gland, and shows some of its lesions, such as mixed tumors, stone, abscess, fistulas, and Hodgkin's disease. This method, which is harmless and without contraindication, may be of diagnostic value in diseases not only of the salivary glands but also of adjacent structures.

E. T. LEDDY, M.D.

**Lipiodol Pelvic Cysts.** A. F. Lash. *Surg., Gynec. and Obst.*, July, 1930, LI, 55.

Since the beginning of the use of iodized oils as opaque media for roentgen examination of the uterine and tubal cavities, there has been present the question of the effect of these oils on the mucous membrane of these cavities and on the peritoneum when spill of the oil from the tubes occurs.

References are given of the experience in using iodized oils diagnostically and therapeutically without unfavorable reactions. Conversely, few reports are cited from the literature illustrating the dangers of the use of iodized oils in spite of asepsis and indications. The author reports such a case in detail and draws the following conclusions, made from an analysis of previous case reports and his

case: (1) In a case of uterus bicornis unicollis, bilateral chronic salpingitis and healed pelvic peritonitis occurred independently of the foreign body reaction produced by the presence of lipiodol in the pelvic cavity. The function of the tubes was not disturbed by the lipiodol as the patient was delivered of a full term child one year after injection. (2) In the presence of infections of the female generative tract, the use of iodized oils is contra-indicated, as their antiseptic properties have not been demonstrated. (3) In some individuals lipiodol may induce foreign body reaction in the pelvis, but it is also true that some specimens of lipiodol (free iodine) may be irritating to any peritoneal surface. (4) The great value of iodized oils in roentgen examination of the female pelvic organs should be appreciated, but due precautions in its use must be observed. It is suggested that the oils be tested for free iodine and that oil injections be used only in the absence of infections of the female generative tract.

D. S. CHILDS, M.D.

#### DENTAL RADIOGRAPHY

**The Significance of the Dental Radiograph and its Interpretation.** James F. Brailsford. *Brit. Jour. Radiol.*, January, 1930, III, 19.

Because some patients are known to retain septic teeth for years without apparent harm, the constant danger of such teeth may not be realized. Septic teeth may be detected by the patient, or the dental surgeon by inspection and clinical tests, and by X-ray examination. In acute inflammation the patient's attention will be called to the disease process, although he may not be able to accurately localize the painful tooth. Chronic sepsis about the apices of pulpless teeth may give no symptoms, and may escape detection even after careful clinical tests. Such chronic sepsis in bone from which toxins are being absorbed should, however, show definite changes in the bone surrounding such lesions by radiographic study. It is the writer's belief that teeth not showing changes on a good radiograph and not painful (as from an acute process) can be considered

as not the source of chronic toxic absorption. The author believes radiographic study should be made by an impartial observer, and emphasizes, in conclusion, that a radiogram may be so poor the most experienced cannot accurately interpret it, while on the other hand it may be good, yet convey little or no information to the observer.

J. E. HABBE, M.D.

#### DIATHERMY

**Destruction of Tonsils by Diathermy.** Warner Collins. *Brit. Med. Jour.*, June 14, 1930, No. 3623, p. 1094.

Other non-surgical measures, for example, X-ray, radium, and electric cautery, have proved inadequate. The author combines true diathermy with fulguration. The area is first anesthetized with a cocaine spray anesthesia, using  $1\frac{1}{2}$  to 2 grains of the hydrochloride dissolved in two drachms of water. It is necessary to work with a temperature between 60 and 100 degrees C., and this is a predetermined constant for the controls of the particular machine. The active electrode is usually a small metal ball mounted on a curved ebonite holder, through which the insulated current is carried. A diathermy current of two amperes is adequate, the frequency of oscillations being about 500,000 per second. A glass tongue depressor is used. The current is not turned on until the active electrode is in contact with the tonsil tissue. The entire operation takes but a few seconds, the tonsil being killed by the production in its substance of heat which causes coagulation of proteins and boiling of tissue fluids. The active electrode is then withdrawn to allow sufficient arcing effectively to seal the smaller blood vessels.

W. D. MACKENZIE, M.D.

**Treatment of Anal Fissure and Spasm by Diathermy.** Frank Howitt. *Brit. Med. Jour.*, June 28, 1930, No. 3625, p. 1168.

The author gives his technic and concludes that this method of treatment leaves no room for doubt but that it is a curative agent of considerable value. In acute cases, which are always attended with a considerable degree of

spasm, the blood supply to the underlying mucous membrane is cut off. This tissue anemia prevents healing and a vicious circle is thus produced. The object of diathermy here is to relax the spasm and increase the blood supply to promote healing.

The indifferent electrode used is the metal abdominal belt described by Cumberbatch. The active electrode is actually inserted into the anus, the size being gradually increased at subsequent treatments up to maximum dilatation. Daily treatments are recommended. In the treatment of chronic cases, the method by Dr. A. F. Hurst is used, giving a much more intensive application of diathermy, with the object of rendering the whole area flaccid and malleable, and then dilating the anal canal manually. A much greater degree of dilatation can be produced after diathermy than is possible without such application.

WALLACE D. MACKENZIE, M.D.

#### GALL BLADDER (NORMAL AND PATHOLOGICAL)

**Joint Changes in Hemophilia.** Thomas Canigiani. *Röntgenpraxis*, June, 1930, II, 511.

The author reports a case of hemophilia in a seven-year-old child, with severe joint changes. Very instructive X-ray films are reproduced, showing definite areas of bone absorption around several joints, atrophy of the surrounding bones, narrowing of the joint spaces, and deformities. One should be able to make a roentgen diagnosis of this disease even in clinically indefinite cases. The differential diagnosis from chronic arthritis, tuberculosis, and syphilis of the joints is not difficult, considering the above-named points.

H. W. HEFKE, M.D.

**Our Experience with Cholecystography.** Karl Gefferth. *Röntgenpraxis*, June, 1930, II, 495.

Intravenous injection of the dye is used by the author because the oral administration, in his experience, sometimes leads to gastrointestinal upsets, and does not seem to be as reliable as intravenous administration. Chole-

cystography appears to be a very efficient means of demonstrating the function of the gall bladder but it is not entirely reliable in the demonstration of stones. A roentgenologically normal functioning gall bladder cannot always clinically be considered normal. The author has seen patients with a diseased gall bladder showing roentgenologically a normal filling.

H. W. HEFKE, M.D.

**Contraction of the Gall Bladder.** Editorial. *Jour. Am. Med. Assn.*, June 28, 1930, XCIV, 2066.

Bile is one of the important digestive fluids, being of particular significance in the digestion of fats in the intestine, where it not only stimulates lipolysis but also serves to dissolve the products of this reaction, thereby aiding the transport through the enteric wall into the body. Between meals the bile from the liver passes into the gall bladder, where it is concentrated and from which it is extruded immediately after food leaves the pylorus. It has been demonstrated repeatedly that fats are especially efficacious in causing a diminution in size of the gall bladder and the flow of bile from this organ into the duodenum; proteins have only a slight effect in this connection and carbohydrates none at all. It appears that the patency of the sphincter of Oddi is affected also by the presence of fat in the intestine and that it acts in a reciprocal manner with the gall bladder.

Recent observations constitute significant evidence that bladder bile is forced into the duodenum by the contraction of the muscles in the walls of the gall bladder. These observations emphasize the probability of an intrinsic mechanism in the contraction of the gall bladder. In no case did the gall bladder empty when fat was given parenterally. Obviously, the stimulus arises through the activity of a mechanism of which the duodenum is a part. Electrical stimulation of the pyloric part of the stomach brings about a contraction of the quiescent gall bladder though similar stimulation of the stomach, cecum, or small intestine, during active emptying after giving egg yolk, causing an inhibition and relaxation, with

withdrawal of bile into the gall bladder. There probably exists a reflex pathway from the splanchnic area to the gall bladder, though the probability of hormone stimulation cannot be disregarded.

The facts point to a large significance of the gall bladder in gastro-intestinal physiology, an argument against the indiscriminate removal of this organ.

CHARLES G. SUTHERLAND, M.B. (Tor.)

### GASTRO-INTESTINAL TRACT (DIAGNOSIS)

**Busi's New Radiologic Sign in Ileocecolic Invagination.** Mario Santoro. *Archivio di Radiologia*, January-February, 1930, VI, 207.

Santoro has found in three cases of ileocecolic invagination the radiologic sign described by Busi in 1926. This sign consists of a more or less complete series of rings made by the barium mixture as it passes between the invaginated and the invaginating intestine, and which is distributed in the narrowed haustura of the invaginating portion. This sign is obtained by administration of the opaque medium by mouth. It is advisable to begin the radiologic examination of such patients with the oral administration of the opaque mixture, and at a second examination use the opaque enema. The three cases were operated on and there were found no alterations in the intestinal walls, from which finding one may place much stress on a spastic contraction of the sphincter of the cecum as an etiologic factor in this lesion.

E. T. LEDDY, M.D.

**Obstruction of the Colon.** George H. Stobie. *Can. Med. Assn. Jour.*, May, 1930, XXII, 650.

Obstruction of the large bowel differs from obstruction of the small bowel in many ways. In the small bowel the obstruction is sudden and complete, whereas in the large bowel it is the culmination of a slowly progressive condition, usually malignant. So that in large bowel obstruction there is not only the acute

condition to be relieved, but the underlying malignancy must be treated.

Cancer of the colon is not diagnosed in 60 per cent of the cases until some degree of obstruction occurs. Hence arises the need for early investigation of colonic disturbances. Increasing constipation, coupled with loss of weight, anemia, and a feeling of fatigue should call for thorough examination of the colon in the following order: (1) digital examination of the rectum; (2) stool examination; (3) procto- and sigmoidoscopic examination; (4) X-ray examination.

Treatment of colonic obstruction should proceed in several stages. Usually a cecostomy should precede excision of the growth.

Obstruction of inflammatory origin, such as from a diverticulitis, can be readily differentiated by the X-ray from malignancy.

Several case reports are cited by the author to illustrate the various conditions mentioned.

L. J. CARTER, M.D.

**Chronic Obstruction of the Duodenum.** Malcolm Thompson. *Southern Med. Jour.*, June, 1930, XXIII, 487.

Little attention is given in text-books to chronic obstruction of the duodenum, although much has been written about it in medical journals.

The causes are usually adhesions and compression. It must be differentiated from gastric, hepatic, cholecystic, pancreatic, and renal disease, as well as other obstructive conditions of the intestine and other lesions of the duodenum. The roentgen ray is extremely valuable in diagnosis, but only those with experience in interpreting gastro-intestinal studies are competent to say whether or not a duodenum is dilated.

W. W. WATKINS, M.D.

**The Roentgen Diagnosis of Gastrocolic Fistulas.** P. Eichler. *Röntgenpraxis*, June, 1930, II, 517.

It is often impossible to demonstrate gastrocolic fistulas by the routine gastric examination. Two such cases are reported, both fis-



tulas having developed after a posterior gastro-enterostomy. Resort must be had to an examination of the colon by means of a barium enema, thus establishing the existence of a communication between the colon and stomach. A more instructive picture, however, may be obtained by giving a small amount of barium by mouth, and then filling the colon with air. The mixture of barium and air plainly shows the fistula.

H. W. HEFKE, M.D.

**Intussusception: Diagnosis and Value of Early Operation.** Harold H. Fox. *Southern Med. Jour.*, June, 1930, XXIII, 509.

The diagnosis is established on the following points: (1) Most important is a carefully taken history from the mother; (2) a freely movable abdominal tumor; (3) blood passed by rectum; (4) vomiting; (5) rectal tumor; (6) negative blood and urine pictures, and lastly, (7) the determination of intestinal obstruction by use of the barium enema, fluoroscopic findings, and roentgenograms.

W. W. WATKINS, M.D.

**The Duodenal Niche—A Criterion in the Healing of Duodenal Ulcer.** Jacob Buckstein. *Surg., Gynec. and Obst.*, July, 1930, LI, 109.

An historical survey of the significance of the niche in the healing of gastric ulcer is presented. A similar significance from a diagnostic and therapeutic standpoint may be attributed to the niche of a duodenal ulcer.

The author states: "Two difficulties arise. An irregular deformity of the duodenal bulb other than niche formation, which subsequently shows complete disappearance after medical treatment, may create the suspicion of having originally been due to spasm or possibly to incomplete filling. On the other hand, a persistent irregularity which remains unchanged in spite of complete clinical recovery over a long period of time does not necessarily mean that the ulcer has not healed. Unyielding scar tissue may be responsible for a deformity that remains permanently demonstra-

ble in the radiogram. A more reliable criterion exists in the study of the changes in the niche of a duodenal ulcer, when this evidence is present. The disappearance of such a niche with clinical cure must be as acceptable as in the case of gastric ulcer."

Three cases are given to illustrate the author's contention.

D. S. CHILDS, M.D.

**The Duodenal Ulcer Crater.** D. B. Harding. *Southern Med. Jour.*, June, 1930, XXIII, 513.

The roentgen diagnosis of duodenal ulcer has become one of the most accurate diagnostic procedures available. This report is based on a study of 214 consecutive cases, in which a diagnosis of duodenal ulcer was made, and has special reference to ulcer craters. The author refers to the technic of Carman and Sutherland of compressing the duodenal bulb in the attempt to catch a fleck of barium in the ulcer crater. The demonstration of a duodenal fleck, when differentiated, justifies an unqualified diagnosis of duodenal ulcer, whether there is deformity of the bulb, or a definite niche is seen.

W. W. WATKINS, M.D.

#### GASTRO-INTESTINAL TRACT (THERAPY)

**Peptic Ulcer: Etiology, History, and Surgical Treatment.** Arthur Dean Bevan. *Jour. Am. Med. Assn.*, June 28, 1930, XCIV, 2043.

Ulcer of the stomach was accurately described as a pathologic entity about a hundred years ago. Peptic ulcer is limited to the anatomic areas that are subjected to the action of gastric juice containing pepsin and free hydrochloric acid; i.e., the stomach, the duodenal bulb, and the jejunum which has been anastomosed with the stomach as in gastro-jejunoscopy, and in rare cases the lower end of the esophagus in close contact with the stomach. Peptic ulcer occurs in at least 10 to 12 per cent of the population. To master this subject one must master the anatomy, physiology, and pathology involved; the etiology and



diagnosis; the roentgenology, and both the medical and surgical treatment.

The duodenal bulb is not a part of the duodenum but a part of the stomach; its blood supply and innervation are the same as those of the stomach and not of the duodenum, and the mucous membrane is separated from the mucous membrane of the duodenum at the line of the sphincter of the duodenal bulb. More than 90 per cent of gastric ulcers occur along the lesser curvature from the esophagus to the pylorus. This is a vestigial structure representing a more complete partial tube in animals that chew their cud. Its mucous membrane differs from that of the rest of the stomach. Its blood vessels are more like end arteries than like those of the rest of the stomach. These anatomic facts favor the development of peptic ulcer in this area.

The essential causes of peptic ulcer are impairment of the vitality by injury, as disease of stomach mucosa and deeper layers to the point where they can be digested by the gastric juice. Lowering of the general resistance of the patient from any of a great number of factors is an added cause. There is little scientific evidence supporting the theory of focal infection from the tonsils or the teeth. Severe acute ulcers of the stomach may be of hematogenous origin, as a rule a part of a general infection.

It is probable that acute ulcers are frequent and that most of these heal spontaneously. The chronic ulcer is maintained by the irritation of the gastric juice, by traumas, and probably by low-grade inflammatory processes. Even the chronic ulcer in the majority of cases heals in time. The fact that peptic ulcer does heal and heals spontaneously must be accepted as a clinical fact. It should be possible by clinical, laboratory, and roentgenologic studies to make the correct anatomic and pathologic diagnosis in about 90 per cent of the cases.

Surgical management is demanded in cases of perforation, in cases in which massive hemorrhages have occurred, and in cases in which the possibility or probability of cancer exists. Deep penetrating and callous ulcers, difficult to heal under medical management, and cases in which cure cannot be effected by proper in-

ternal management should also have surgical intervention. The real problem in clinical work is the difficulty, at the time of operation, of making a positive diagnosis between a callous ulcer and a cancer of the stomach. Gastro-enterostomy has much to recommend it in surgical treatment of ulcer of the duodenum and stomach ulcers close to the pylorus. In callous ulcers of the stomach, resection is usually indicated. Partial pylorectomy has a definite place.

The field of peptic ulcer belongs to no one specialty. The general practitioner, the internist, the surgeon, the roentgenologist, and the pathologist are all concerned. Eighty per cent of the cases of peptic ulcer can be cured by good medical management. This is a field for good team work, and only where such team work has been developed can the ulcer patient receive the best that modern scientific medicine has to offer.

CHARLES G. SUTHERLAND, M.B. (TOR.).

#### GENITO-URINARY TRACT (DIAGNOSIS)

**Diseases and Anomalies of the Ureters.**  
R. A. McComb. *Can. Med. Assn. Jour.*,  
April, 1930, XXII, 484.

The introduction of pyelo-ureterography has demonstrated that the ureter is frequently a potent factor in the causation of renal disease. Since the ureter is an aqueduct, and since the efflux of urine is produced by an intermittent muscular contraction starting in the pelvis of the kidney and ending at the ureteral orifice, it will readily be seen that any obstruction will increase the peristalsis, and tend to produce dilatation above the site of obstruction, extending into the kidney itself. The symptoms and end-results are the same, whatever the cause of the obstruction may be. They are pain, dilatation, infection, renal damage, and possibly calculus formation.

The most common conditions drawing our attention to the ureter are ureteral calculus and stricture. Ureteral stricture occurs chiefly at the uretero-pelvic junction, the brim of the

true pelvis, or the intra-mural portion of the ureter. The cause of its formation is believed to be largely inflammatory. Some cases are a legacy from the pyelitis of infancy and childhood; hence, the necessity for early recognition of stricture in connection with the persistent urinary conditions of childhood. Less frequent causes of ureteral obstruction are an aberrant vessel or a band of fascia, when associated with renal ptosis.

The anomalies of the ureter are briefly discussed by the writer. Ureteral disease is progressive and ultimately destroys the kidneys.

L. J. CARTER, M.D.

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**Ureteral Calculi: Based on Over Two Hundred Consecutive Cases in the Author's Service.** Winfield Scott Pugh. *Med. Jour. and Rec.*, June 4, 1930, CXXXI, 548, and June 18, 1930, CXXXI, 608.

Any case presenting the symptom-group of pain, hematuria, urgency, frequency, or any of these symptoms, calls for a complete urological examination. With such a picture, justice to the patient can be done only by cystourethroscopy, ureteral catheterization, renal function tests, and pyelography.

Seventy-six per cent of ureteral stones are in the lower ureter, but they may locate anywhere. About 80 per cent of ureteral stones will show clearly on a plain X-ray film, but it is often impossible by this simple examination to tell definitely whether or not they are in the ureter. Bransford Lewis' method is to have the stone shadow follow his dilator. The double exposure method, suggested by Ball in 1918, is used by the author. This consists in making two exposures on the same film, moving the tube between exposures. If a stone is in the ureter it will maintain the same relation to the catheter; if extra-ureteral, the shadow will show a difference in this relation in the two exposures.

(Note: The same information may be obtained by making stereoscopic films with a cross-shift of the tube. This has the added advantage of giving a stereoscopic roentgenogram for detailed study.)

W. W. WATKINS, M.D.

**Pyelography Following Intravenous Injections.** N. E. Berry. *Can. Med. Assn. Jour.*, April, 1930, XXII, 546.

The members of the author's staff had noticed for a long time that the roentgenograms of the kidney, taken following the examination of the gall bladder by the Graham method, showed better defined kidney shadows than those obtained in the usual roentgenogram. It seemed, therefore, that some such intravenous injection might be of use as an additional aid in certain cases where an accurately defined kidney shadow is imperative, and that, incidentally, the renal pelvis might be visualized.

This idea was followed out in the Department of Urology of the Royal Victoria Hospital, Montreal. Sodium iodide was chosen as the opaque medium, both alone and in combination with other preparations. The experimental work was done on rabbits. It was found that a simple mixture of sodium iodide and urea was tolerated in enormous doses, provided the urea was in excess. It was found that with doses of two grams each of iodide and urea given to a rabbit weighing one kilo, the kidney pelvis could not be outlined, even with the ureter ligated, but that the bladder could be outlined with much smaller amounts, provided it did not contain more than 10 c.c. of fluid.

Experimental work is being done on a preparation for human use. The new method will be applicable only to the very difficult cases.

L. J. CARTER, M.D.

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## GYNECOLOGY AND OBSTETRICS

**Pseudomyxoma Peritonæi Secondary to Ovarian Cystadenoma.** James C. Masson and Robert A. Hamrick. *Can. Med. Assn. Jour.*, April, 1930, XXII, 508.

This is a condition of the peritoneum in which masses of gelatinous, pseudomucinous or mucinous, material are distributed over the surface, either as a homogeneous layer, or in the form of multiple cystic masses. The cause of the condition is invasion of the peritoneum by material from a ruptured pseudomyxomatous cystadenoma of the ovary, or from a mu-

cocele of the appendix. The condition may be either benign or malignant. When the condition is benign, surgery will usually be sufficient, although a number of operations may be required. When the condition is malignant, the malignancy is usually of low grade. Both ovaries and tubes should be removed, with as much of the mucinous material as possible. As a rule, the uterus should also be removed. Extensive treatment with radium and X-rays should follow. A considerable extension of life and some cures may be expected.

L. J. CARTER, M.D.

**Histologic Studies of the Uterine Mucosa after Radiologic Castration.** Antonino Nicotra. *Archivio di Radiologia*, January-February, 1930, VI, 268.

The author examined histologically curettings from the uteri of three patients at the first or second menstrual period after "castration." The endometrium was normal in each case.

E. T. LEDDY, M.D.

**Further Experience with Roentgen Abortion.** M. Ganzoni and H. Widmer. *Strahlentherapie*, 1930, XXXVI, 510.

The authors report in this paper their experience with an additional 39 patients, abortion being induced by roentgen rays. The minimum dose effective in the uterus is about 300 r. From the tabulated case reports it appears that from 250 to 450 r, as measured on the cervix, were given. In three patients, the abortion started 152, 155, and 180 days, respectively, following irradiation.

E. A. POHLE, M.D., Ph.D.

**Radiographic Therapy of Sterility.** Francillon Lobre. *Brit. Med. Jour.*, March 29, 1930, No. 3612, p. 611.

Contra-indications to radiographic examination were the presence of active lesions, such as those accompanying metritis, salpingitis, appendicitis, or metrorrhagia. The best time for the exploration was the week following menstruation, from the fourth to the twelfth day.

At this period adnexal reactions could be most effectively avoided; moreover, the risk of infection during pregnancy was eliminated by choosing a time shortly after menstruation had occurred. It was necessary to be sure that the cervical orifice was permeable, since radiographic examination was never to be immediately preceded by dilatation of the cervix. In order to ascertain whether the tubes were or were not permeable, a second radiogram had to be taken a few hours after the first to discover if the shadow still remained in the tubes, or was disseminated in patches in the abdominal cavity. For the purpose of this second examination the patient remained in the hospital or clinic a few hours before returning to her home. To avoid pain sodium bromide or benzyl benzoate was given for two or three days before the examination, and an analgesic suppository was introduced one and one-half hours before the examination, which was immediately preceded by swabbing the cervix with a solution of novocain.

The opaque substance used was 40 per cent lipiodol, rendered more liquid by warming on the water bath. It was well tolerated by the tubes. The pressure employed might be higher (up to 30 cm. of mercury) than was permissible when air was insufflated (in this case up to 23 cm. of mercury).

However highly the method might be perfected it would never constitute a specific treatment for sterility, since some forms are not mechanical in origin. The method confirmed and precisely demonstrated the clinical findings, and, likewise, supplied data giving rise to new medical and surgical methods of treatment.

For combating uterine or tubal spasm antispasmodic agents, such as belladonna, atropine, benzyl, or the bromides, might be used. If the tubes presented unduly small caliber, they might be first rendered permeable by injecting them with lipiodol, and their dilatation might then be attempted by repeating insufflation for a sufficient number of times.

Before undertaking operative measures designed to combat sterility, hystero-graphy should be practised. Ligamentopexy, or stomatoplasty, should not be attempted without

assurance that the tubes are permeable. If permeability was not present, an attempt should be made to restore it. Twenty operations of this kind had been undertaken by the author, following advice based on radiosopic findings. Thus far the results had not been satisfactory, and in no case had pregnancy followed surgical treatment. Radiographic examination not only permitted etiological diagnosis, but often sufficed in itself to constitute the treatment of certain forms of sterility.

WALLACE D. MACKENZIE, M.D.

### HEART AND VASCULAR SYSTEM (DIAGNOSIS)

**Observations on the Clinical Value of the Roentgen Ray in the Diagnosis of Cardiovascular Disease.** Paul D. White. *Am. Jour. Roentgenol. and Rad. Ther.*, April, 1930, XXIII, 353.

The author presents several observations concerning the limitations of roentgenological study of cardiovascular disease, against which are balanced six reasons why this method of examination is worthy of routine application. The limitations are: (1) the method alone is quite incomplete and it ranks below careful history and physical examination; (2) it is least accurate in detecting the earliest stages of cardiovascular disease when laboratory confirmation is most needed for positive diagnosis; (3) certain serious and even fatal heart diseases may be present, such as coronary disease, and the roentgen findings may be entirely normal; (4) roentgenological studies while at first thought apparently to offer mathematical accuracy are in reality crude, because so largely dependent upon changes in size and shape, but slight changes due to early disease may not be distinguishable from variations within normal limits; (5) slight technical errors may result in most erroneous interpretations, hence clinical methods should be used to check the X-ray, just as the X-ray may be used to check clinical examinations; (6) the roentgenologist or internist making the X-ray examination should describe structural change only, and not

attempt to make an etiological diagnosis; (7) the examination must be complete, including fluoroscopy in all positions.

The reasons for making the X-ray study as routinely as possible are: (1) skillfully applied, the method affords the most accurate measurements of the size and shape of the heart; (2) in the presence of obesity, emphysema or other condition making physical examination imperfect, the X-ray may be the only means of obtaining accurate measurements; (3) surprising and unexpected findings (for example, aortic aneurysms and pericardial calcification) may occasionally be demonstrated; (4) the size of the aorta and left auricle can be determined only by the X-ray; (5) hilum shadow changes and pulmonary artery abnormalities can be shown only by this means; (6) the roentgenoscopic observation of peculiarities of pulsation of the heart chambers and great vessels is alone worth the method of study.

J. E. HABBE, M.D.

**A Standardization Roentgenologic Study of the Heart and Great Vessels in the Left Oblique View.** George H. O'Kane, Fred D. Andrew, and Stafford L. Warren. *Am. Jour. Roentgenol. and Rad. Ther.*, April, 1930, XXIII, 373.

The authors present a standard method for determining the relative size of the right and left ventricles. Area measurements on the left oblique postero-anterior view, with the right and left ventricles in profile, are said to be more accurate and to give a better index of cardiac volume than the postero-anterior view. The patient is routinely fluoroscoped first and the optimum angle (between 40° and 60°) determined for best visualizing the aorta and pulmonary vessels.

The technical factors are six-foot target-film distance, two-tenths second, 60 to 100 K.V., breath held in deep inspiration. Film measurements are made as follows: a base line is drawn from the notch between the right ventricle and aorta to the notch between the left ventricle and left auricle. The pulmonary



artery and aorta overlap each other at their bases about half of their respective diameters. A line erected perpendicular to the base line at the mid-point of this overlap will represent the interventricular septum, dividing the two ventricles. Lines are then drawn perpendicular to the last line to the borders of the right and left ventricles to determine their size. The diameters of the aorta, pulmonary artery, and aortic arch are also constructed. The heart area is computed on that portion of the heart shown below the base line, and, therefore, measures ventricle size only.

For simplification of comparison, hearts are grouped as normals, left ventricular and right ventricular preponderance, and generalized dilatation. A table of average measurements for these four groups is appended. Certain types of cases were found to show definite evidence of right ventricular preponderance on the oblique view, which the postero-anterior view failed to show.

J. E. HABBE, M.D.

**Roentgenological and Pathological Findings in Some of the Valvular Lesions.**  
David Steel, *Am. Jour. Roentgenol. and Rad. Ther.*, April, 1930, XXIII, 384.

The author presents only those cases studied roentgenologically which were subsequently studied and checked by postmortem examination. Cardiac hypertrophy produces changes in the shape of the cardiac silhouette, while dilatation results in increase in size. The following signs are to be looked for in suspected enlargement of the left ventricle: (1) increase in the left median distance and horizontal diameter; (2) sharply defined junction between left auricular appendage and left ventricle; (3) absence of elevation of apex on deep inspiration; (4) elliptical to parabolic left lower arch; (5) change in ventricular pulsations; (6) an obliquely placed ovoid silhouette; (7) the bi-diaphragmatic angle remains inside the heart shadow, with the patient in the second oblique position, even on deep inspiration.

In aortic stenosis the predominating change is an hypertrophy of the left ventricle, with a

bulging of the lower left arch, but without much increase in the left median distance. If dilatation also exists the cardiac apex will be spread. The roentgenoscopic findings are important. The pulsations are slow and forceful.

In aortic insufficiency there is a marked increase in the left median distance because dilatation overshadows the hypertrophy. The left lower arch becomes rounded and the great vessels appear to ride on the horizontal portion, producing a "duck-shaped" or "shoe-shaped" heart. Pulsations increase rapidly. The aortic shadow is dense and dilated in all diameters.

The findings in mitral lesions have been previously described in detail by the author.

In combined mitral and aortic lesions, the cardiac silhouettes are intermediary and depend upon the predominating lesion. Superimposed upon the monotonous upright silhouette of a mitral lesion are the changes produced by the aortic lesion, with associated insufficiency. The heart is partially oblique and presents a "stair-step" left border. With aortic stenosis complicating a mitral heart, the aortic lesion may be best detected by the character of the pulsations.

J. E. HABBE, M.D.

**Some New Critical and Experimental Contributions to the Clinical Study of the Volume of the Heart.** Giovanni Giordano. *Rivista di Radiologia e Fisica Medica*, January, 1930, II, 26.

The author describes some studies on the volume of the heart made according to the methods of Brugsch, Geigel, Salotti, and Cignolini, in which the orthodiagraphic method was used as the basis of calculation. As test objects, radioplastic nodes, according to the method of Palmieri, were used. Giordano believes that the mathematical method of Salotti is less subject to error than the others and is, therefore, the most valuable method to use in large-scale researches, particularly since it is very simple to carry out.

E. T. LEDDY, M.D.



### LIGHT THERAPY

**Specificity of Light Action in Tuberculosis.** Winthrop M. Phelps. *Jour. Bone and Joint Surg.*, April, 1930, XII, 253.

The outdoor sunshine of the Alps, the sea shore, and even of smoky sea-level cities can be used to advantage in the general treatment of tuberculosis, but sunshine filtered through window glass is practically valueless. Smoky sea-level air transmits practically no radiation shorter than 3,200 Å., and window glass transmits only feebly radiation shorter than 3,800 Å., so the radiation useful in tuberculosis must lie between these two points in the (invisible) ultra-violet region of the electromagnetic spectrum.

Phelps records thirty-four cases of tuberculosis of glands, bone, peritoneum and other tissues treated with sunshine in the sea-level manufacturing town of New Haven. Most of the patients were children from six months to fourteen years of age and the period of treatment varied from six weeks to three years. In most instances results were considered good. Sinuses healed and function was improved. It is felt that possibly the effect is general for chronic wounds and not specific for tuberculosis.

Dosage was controlled by a radiometer on the roof of the hospital connected to a recording device inside the building. Readings were in units of gram calories per square centimeter of body surface per minute, and the empiric dose was 90 units front and 90 units back daily. This required exposure times varying from 55 minutes front, 55 minutes back, to two hours front and two hours back, depending on the weather. On cloudy days exposure throughout the day did not deliver the desired dose, and to meet this difficulty, as well as the problem of exposure on severe winter days, artificial radiation was required.

"Pan-Ray-Arc" lamps were used, equipped with aluminum reflectors and 13 millimeter diameter "Sunshine Carbons." Working at 30 amperes (voltage not stated), the intensity at one meter distance was approximately one gram calorie per square centimeter per minute.

The spectrum of the lamp was rich in the desired wave lengths (3,200 to 3,800 Å.), but

included also shorter radiation (for instance, the ultra-violet 3,000 to 3,130 Å. specific for rickets) and much of the visible spectrum (4,000 to 8,000 Å.).

Patients received unfiltered radiation, but a few animal experiments suggest that it may be advantageous to filter the beam with Corning glass filter No. G986A, which removes most of the radiation shorter than 3,200 Å. and longer than 3,800 Å., thus avoiding the excessive tanning and erythema so characteristic of radiation between 3,000 and 3,200 Angström units.

PAUL C. HODGES, M.D.

**Carbon Arc Light Treatment in Bone and Joint Tuberculosis: Observations on the Methods and Immediate Results of Treatment with the High Intensity Carbon Arc Light in Tuberculosis of the Bones and Joints.** Katharine Pardee. *Jour. Bone and Joint Surg.*, April, 1930, XII, 270.

The winter climate in Baltimore is not satisfactory for the treatment of surgical tuberculosis, and the Children's Hospital School finds it necessary to use artificial radiation for almost six months of the year. Quartz mercury lamps have been tried in previous years without success (no information as to current, filter, exposure time), but a new carbon arc lamp operating at 90 amperes is considered of definite value.

The illustrations suggest that the "lamp" is really several carbon arc burners, so there is some question as to whether the current stated is for one burner or for a group. The distance from arc to patient appears to be approximately 10 feet, and the exposure time is 15 minutes front and 15 minutes back daily.

Twenty-two children treated throughout the winter show in most instances gain in weight, increased red blood cell count, improvement in general bodily condition, and improvement in the X-ray appearance of the bone lesions.

PAUL C. HODGES, M.D.

### NERVOUS SYSTEM (GENERAL)

**The Direct and Indirect Action of X-rays on the Suprarenals. II.—The Variations in**

**Blood Sugar.** Quintino Vischia. *Rivista di Radiologia e Fisica Medica*, January, 1930, II, 71.

Experiments carried out by the author in which the suprarenals of dogs and rabbits were irradiated showed that a hyperglycemia is produced. It begins immediately after irradiation and lasts several hours. The author discusses various explanations for this finding, and concludes that irradiation of the suprarenals had a definite effect on the vegetative and especially on the sympathetic nervous system.

E. T. LEDDY, M.D.

**The Capillary Changes Produced by X-rays.** Luigi Turano. *Archivio di Radiologia*, March-April, 1930, VI, 349.

The author demonstrates the peculiar differences between a normal capillary microscopic field and a pathologic one, and points out how the changes produced by X-rays may be followed by the capillary microscope, enabling one to prognosticate the radiosensitivity of the case in point by observation and study of the changes in the capillaries, which may be dilated or constricted. He regards these alterations as manifestations of changes in the balance of the vegetative nervous system.

E. T. LEDDY, M.D.

**The Effect of X-rays on Microglia.** Desiderio Perotti. *Rivista di Radiologia e Fisica Medica*, March, 1930, II, 171.

After a short review of the nature and function of microglia, the author describes some experiments which he carried out on the effect of X-rays on the reticulo-endothelium of the central nervous system, to which the microglia belong. He treated the brains of rabbits and dogs with increasing doses of X-ray, and killed the animals at various periods after the exposures. He found that the microglia are the most sensitive element in the central nervous system, and that their sensitivity was even greater than that of the endothelium of the blood vessels. He concludes that the great sensitivity of the microglia is due to the func-

tion of defense of these microglia as part of the reticulo-endothelial system, and that these cells are less differentiated than others in the nervous system.

E. T. LEDDY, M.D.

## RADIUM

**Radium Treatment of Cancer (Cancer of the Skin: Measurement of Radium Dosage).** John Murdoch. *Brit. Med. Jour.*, May 17, 1930, No. 3619, p. 911.

*Cancer of the Skin.*—In cancer of the skin the superiority of radium over X-ray therapy has been demonstrated, though it is not yet clear whether this is due to the shorter wave length of the gamma rays or to the fact that radium was continuously applied. According to recent research in Brussels it seems probable that in order to produce the same amount of biological action, such as an erythema dose in the case of the skin, it is necessary to apply to the tissues a much larger amount of energy in the form of gamma rays than in the form of X-rays. The proportion is about four to one.

Cancer of the skin is never too large or too advanced for radium therapy.

In cancer of the tongue, the condition most willingly handed over by the surgeon to the radiotherapist, even a slight improvement on the surgical results is a great boon to the patient. Yet, cancer of the tongue is not a radiosensitive variety and the radiosensitivity of the glandular metastases is even less than that of the primary lesion. Owing to the bad results obtained by deep X-ray therapy, preference is given to local radium treatment.

Cancer of the cervix uteri was one of the first cancers to be successfully treated by radium, the good results being primarily due to the anatomy of the parts. X-ray methods have also reached in this condition a high degree of perfection, and, far from being opposed to each other, the two methods are probably destined more and more to be used together. Radium therapy of the cervix uteri appears to have a slight advantage over surgery.

The introduction of radium into the lumen of the esophagus has proved a failure.

Radium in cancer of the rectum gives similarly disappointing results, but the ingenious method of Neuman and Coryn of interstitial needling is used in inoperable cases and sometimes results in making a case operable.

*Measurement of Radium Dosage.*—The various units of radium absorption which have been put forward from time to time are discussed, and reasons given why in Belgium the ingenious method brought out by Stahel in 1928 has been adopted. This is expressed in ergs per cubic centimeter for the amount of radium energy absorbed. Many slides were shown by the speaker (the paper was presented originally in the form of a lecture), illustrating the disposal of the radium tubes so as to secure homogeneous radiation, tables were given for the distribution of the energy, and an explanation of his method of interstitial radiation by means of needles laid parallel, as nearly as possible, in the tissues. The limitations of the "bomb" method as compared with the interstitial method for securing intense action on the growth were discussed.

WALLACE D. MACKENZIE, M.D.

**Retrograde Needling: A New Technic for Inserting Radium Needles in Carcinoma of the Tongue.** K. H. Pridie. *Brit. Med. Jour.*, March 1, 1930, No. 3608, p. 380.

This method was devised to hold the radium needles in place in spite of the mobility of the tongue and the movements incident to deglutition, when the growth is in the epiglottic region and the base of the tongue is infiltrated.

The radium needles to be used are threaded on a long length of Pagenstacher No. 2 and knotted once over the eye. The tongue is drawn forward and a Greig-Smith abdominal needle is introduced into the space between the hyoid bone and the mandible; a finger introduced into the mouth guides the needle so that it comes out through the margin of the growth into the mouth. One end of the thread attached to the radium needle is then threaded through the Greig-Smith needle, which is withdrawn through the skin of the neck, and detached. By pulling on this thread the radium needle is drawn backwards into the growth till

the point just disappears. A small piece of rubber tube is threaded on the end where it comes out of the skin, to indicate the depth of the needle in the growth. A piece of rubber tubing is threaded on to the other end to protect the lip, and both ends are knotted together loosely, forming a complete loop. In a similar manner, other needles are placed all around the growth.

By pulling the threads the needles can be made to travel either down into the deeper parts of the tongue and glands and finally out through the skin in the submaxillary triangle, or up into the mouth.

WALLACE D. MACKENZIE, M.D.

**Radium Treatment of Cancer of Rectum.** Sir Charles Gordon-Watson. *Brit. Med. Jour.*, May 24, 1930, No. 3620, p. 951.

In 1927, the author regarded a preliminary colostomy as an essential part of radium treatment of rectal carcinoma, but since then has treated a number of cases without colostomy, with equally good results. The greatest obstacle to efficient radiation is difficulty of access. The strongest argument that can be urged for radium in a case considered suitable for radical surgery, on both local and general grounds, is a reasonable prospect of destruction of the growth, with restoration of rectal function, and without expectation of recurrence.

In the treatment of inoperable cases there is a marked improvement both in the general and local conditions, in cases treated by colostomy and radiation. It is further demonstrated that, even in cases which had been submitted to colostomy some months previous to radiation, rapid marked general improvement followed radiation, though local changes might be absent.

Borderline cases offer an even more useful field for radiation, either as a forerunner of excision, or, in some instances, with prospects of cure without excision—some of these (high rectal growths) are treated by radiation through an abdominal incision. Radium has a further valuable field in the early treatment of local recurrence after excision.

It is concluded that, while at present surgery holds first place, it is reasonable to anticipate that radium may become the method of choice in the near future.

W. D. MACKENZIE, M.D.

### ROENTGEN THERAPY

**Anemia, Age of Cell, and Susceptibility to Radiation.** Otto Dyes. *Strahlentherapie*, 1930, XXXVI, 552.

The author epilated the scalp in a number of patients by using a cone attached to the tube holder. On those spots where the cone pressed on the scalp, thus rendering it anemic, the hair did not fall out as in the remaining part of the field, following the application of 640 r. This remaining hair fell out several months later, but only very gradually. He concludes from this observation that the epilation dose for anemic skin is much higher than for normal skin. A similar difference in susceptibility was seen between the hair irradiated for the first time and the regrown hair. If four months after the first application of 640 r the same dose was repeated, delayed epilation occurred.

E. A. POHLE, M.D., PH.D.

**The Roentgen Treatment of the Lymphatic Tissue in the Pharynx during Childhood.** Herbert Schönfeld and Gottfried Baumbach. *Strahlentherapie*, 1930, XXXVI, 472.

During the past three years the authors have treated with roentgen rays 150 children ranging from 3 to 13 years of age, who were suffering from hyperplasia of the tonsils. Technique: 180 K.V., 0.5 mm. copper + 1 mm. Al, half value layer in copper = 0.9 mm.,  $6 \times 8$  sq. cm. field on each side of the neck. The dose in the lymphatic tissue amounted to about 180 to 300 r. The treatment was sometimes repeated four weeks after the first exposure and, if necessary, eight weeks after the second. More than three treatments were not given. One hundred and six cases could be followed up; in 57 per cent the tonsils reduced often to normal size, while in 43 per cent no change in

size occurred. From two to three years after X-ray treatment the tonsils had remained small in only 47 per cent, which means a recurrence of 28 per cent. The relief of the symptoms accompanying the tonsil hypertrophy, as, for instance, sleeping with open mouth, snoring, frequent infections of the throat, was definite in all cases which had responded to treatment. No chronic changes in the mucous membranes or glands due to the irradiation were observed. It is concluded that X-ray therapy of hypertrophic tonsils is chiefly indicated in children subject to frequent infections of the nose and throat.

E. A. POHLE, M.D., PH.D.

**Roentgenotherapy of Diseases of the Hematopoietic System.** Eugenio Milani. *Archivio di Radiologia*, March-April, 1930, VI, 379.

This is an excellent and succinct review of what is known about the radiotherapy of diseases of the blood-forming system.

E. T. LEDDY, M.D.

**Principles of Roentgenotherapy. V.—The X-ray Laboratory: General Treatment Technic.** Ernst A. Pohle. *Wisconsin Med. Jour.*, May, 1930, XXIX, 268.

This is the fifth paper of a series on this subject, and deals briefly with the equipment necessary for therapy and the protection of the operator and the patient. The author discusses the four principal methods of administering X-ray therapy: (1) the single massive dose; (2) the fractional dose; (3) the saturation method; (4) the prolonged exposure.

The importance of keeping detailed records and of standardization in treatment are also discussed in this paper.

W. W. WATKINS, M.D.

**Our Experience with Spleen Irradiation in Chronic Myelogenous Leukemias.** A. Rikl. *Med. Klin.*, June 13, 1930, XXVI, 891.

The author reports his success with spleen irradiation in thirty-one cases of chronic myelogenous leukemia. The treatment factors were: 165 K.V., 4 ma., 40 cm. distance, and a



filter of 0.5 mm. Zn and 1 mm. Al. The time of exposure was varied according to individual indications. Many of the patients acquired a refractory state after repeated irradiation, evident in the blood picture as well as in the behavior of the splenic tumor. In six of these patients the disease could finally not be influenced at all, and the terminal picture of increasing cachexia, intermittent fever, and a hemorrhagic diathesis did not yield to any amount of irradiation. At the beginning of the roentgen therapy in these thirty-one cases, no refractory state had been observed to exist. The final failure of irradiation therapy shows that we are treating only a symptom of the disease and that we do not as yet have the causative factor for it. However, roentgen therapy of myelogenous leukemia is held to have its indication and its value.

H. W. HEFKE, M.D.

#### SKIN (THERAPY)

**Blastomycosis of the Eye.** S. Hanford McKee. *Can. Med. Assn. Jour.*, April, 1930, XXII, 501.

Blastomycosis, or blastomycetic dermatitis, is a chronic disease of the skin caused by a fungus, and frequently involves the eyelids. The writer goes into the etiology, pathology, and diagnosis of the condition. The treatment may be summed up in two measures: the administration of heroic doses of iodide of potassium, and the use of the roentgen rays.

L. J. CARTER, M.D.

**Radiotherapy in Dermatology.** R. H. Stevens. *Illinois Med. Jour.*, May, 1930, LVII, 336.

The author makes a strong plea for a better understanding of the physical agents used in radiotherapy, and pleads for a closer co-operation between the radiotherapist and dermatologist. He discusses in detail, facts and theories of skin structure and function, stressing the probable biologic effects of radiation.

The types of electromagnetic waves used are described and indications for use given. "One should first of all make a diagnosis, if possible, and then determine whether the trouble is or

is not 'light disease.'" In discussing treatment by X-ray, Stevens says: "Just remember to accommodate the wave length to the depth of the primary pathology . . . Remember that the primary action of the ray is not the only action."

An abstract cannot do justice to this excellent paper.

C. H. DEWITT, M.D.

**On the General Body Exposure with Bucky's Borderline Rays in Skin Diseases.** Herbert Fuhs and Josef Konrad. *Strahlentherapie*, 1930, XXXVI, 520.

The authors have studied the effect of general body exposures to roentgen rays of long wave length (1 to 2 Å.) in 104 patients suffering from twenty-one different skin diseases, and have come to the following conclusions. In variance with the observations of Bucky, Spiethoff and others, no definite therapeutic effect on skin diseases could be observed from general body exposure to borderline rays. It is possible, however, that with the improvement of apparatus and technic this preliminary impression may have to be revised.

E. A. POHLE, M.D., Ph.D.

#### TUBERCULOSIS (DIAGNOSIS)

**Tuberculosis of the Symphysis Pubis.** Harold C. Bean. *Jour. Bone and Joint Surg.*, April, 1930, XII, 345.

The author reviews the literature on this subject and adds one case. A young woman twenty-three years of age had suffered from low back pain and limping for two years, unrelieved by sacro-iliac belts and pelvic surgery. Finally pain at the symphysis appeared, and X-rays showed destruction of bone. A diagnosis of osteitis fibrosa cystica was made, sequestrectomy and bone graft ankylosis were done, and biopsy showed tuberculosis. There was complete relief from symptoms.

These cases are commonly silent during the early stages except for secondary symptoms of strain at the sacro-iliac joint, and are apt to escape detection until a mass develops or irradiation of the symphysis is done.

PAUL C. HODGES, M.D.

**RADIUM WANTED**—Will buy 5 and 10 milligram plaques and needles. State lowest cash price and send copy of Manufacturer's Certificate. Also 5 and 12½ milligram needles and 25 milligram tubes for sale. W. M. Sheridan, M.D., Spartanburg, S. C.



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